For engineers who design and manage the power and plant services

Power

JANUARY 1960

ONE DOLLAR

A McGRAW-HILL PUBLICATION

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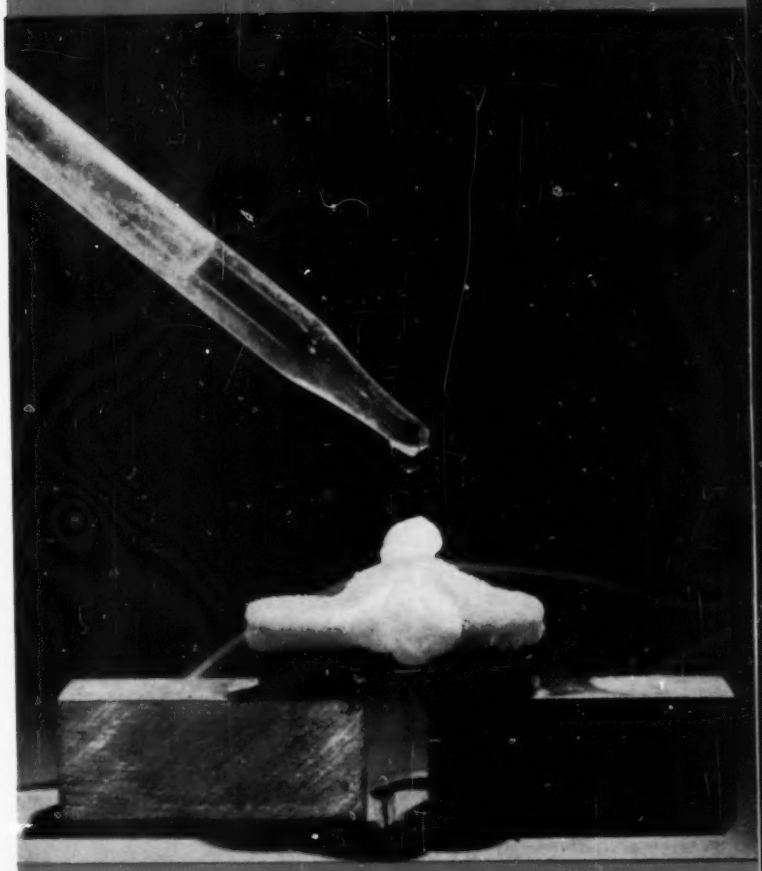

a *TD* report

New interest in thermoelectrics

▶ 57

175 carloads of pipe. Not much . . . if you are thinking in terms of ordinary cast iron pipe. Quite a bit, however, when it's chrome-iron alloy Ashcolite, cast by the sand-spun process. It represents a great many power plants when you consider its limited use—that of conveying ash from the hopper to temporary storage or fill area for final disposal.

We pioneered this industry, back in 1919. Since then we've introduced the major developments, including the use of centrifugally cast wear-resistant pipe. Our years of experience, our careful consideration of job-required details, won us our position of leadership in every corner of the globe. These same attributes can be put to work for you —immediately. Write, wire or phone us . . . THE ALLEN-SHERMAN-HOFF COMPANY, 259 East Lancaster Avenue, Wynnewood, Pa. Cable: Ash-Wynnewood.

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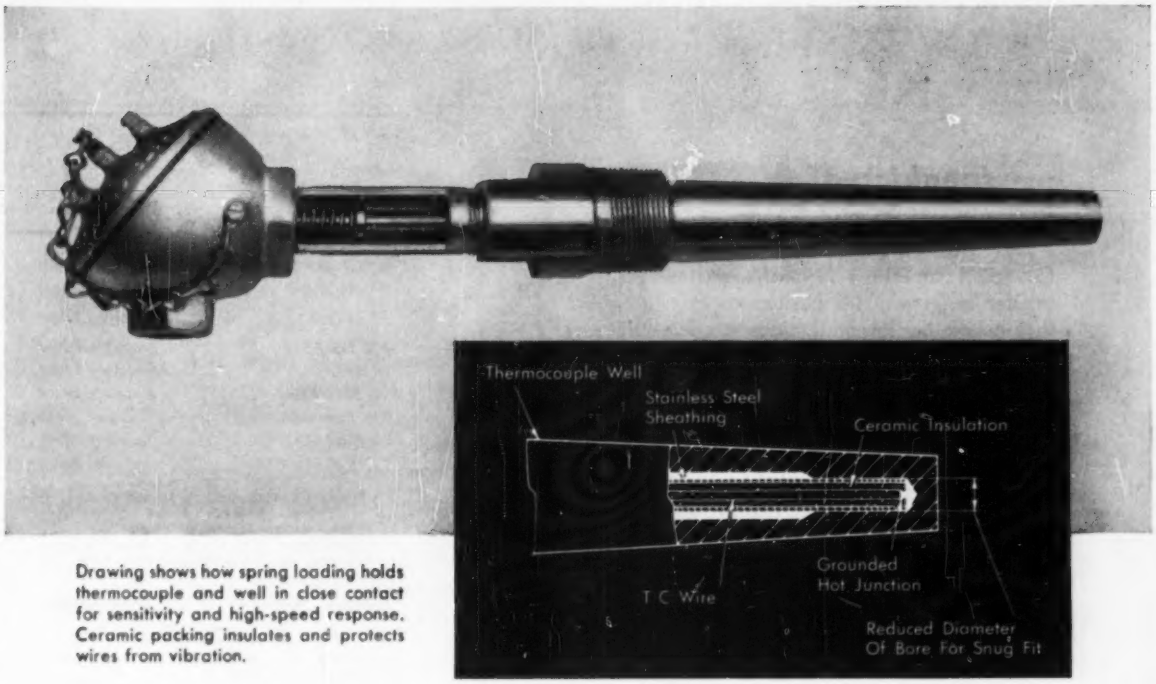

Drawing shows how spring loading holds thermocouple and well in close contact for sensitivity and high-speed response. Ceramic packing insulates and protects wires from vibration.

measure temperatures of high-pressure, high-velocity steam with

New spring-loaded thermocouple

- **High sensitivity**
- **Fast response**
- **Rugged well design**
- **Field-proved**

Design of this rugged, fast-acting thermocouple has been improved to combine high sensitivity with superior mechanical strength.

The thermocouple element is protected from vibration by an inert magnesium oxide packing which holds wire in place inside a stainless steel tube. Two features assure high-speed response to temperature changes: (1) the bore in the well is large enough to permit easy removal of the thermocouple element, and has a smaller diameter near the hot junction to provide a tight fit for highest sensitivity; and (2) spring loading provides positive, metal-to-metal contact between thermocouple and well, for highest rate of heat transfer to the measuring section.

Available in three styles: single-tapered and threaded, and single-tapered for welding in a drilled hole, or double-tapered for welding in a drilled and reamed tapered hole. For working pressures to 5000 psig, temperatures to 1250° F., velocities to 225 fps.

Your nearby Honeywell field engineer can give you complete details. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

75th YEAR — PIONEERING THE FUTURE

● **REFERENCE DATA: Write for Specification S801-1a**

Honeywell

First in Control

SINCE 1885

For more facts circle 204 on Reader Service card, p 101

speaking of **Power**

Covering meetings of professional people is a regular assignment for business-paper editors. But they handle the job quite differently from the way a newspaper reporter does. The newsman is looking for timely information that will interest a wide lay audience. The business-paper editor is seeking timely information of *practical value* to a technically trained, sophisticated audience—the type of information generally of little interest to the layman. Getting this kind of know-how takes more than the straight reporting of events as they happen.

I was reminded once again of this fact last month at the ASME Annual Meeting in Atlantic City. At one point there were five POWER editors in attendance—getting to know the problems of men who will be making power news tomorrow, contributing to committee meetings as ASME members, sitting in on the regular technical sessions.

Much of the data picked up will never appear as such in the magazine but it does keep the editor on top of his technical specialties. It also serves as background for an editor who must decide daily on the soundness, the newness, the usefulness of submitted manuscripts.

Power editors, as engineering journalists, are constantly on the watch for newsworthy items. But because of their close contacts with the field and the men doing important things in that field, POWER editors often know of developments long before the news can be released.

This was the case with our November article on magnetohydrodynamic generation, a development we had known of, on a confidential basis, for some time. The exclusive technical story, prepared for POWER, preceded by several weeks the general press announcement of areas for further MHD investigation by Avco and a group of ten utilities.

Lou Rowley

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Print order this issue: 49,708

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly by McGraw-Hill Publishing Company, Inc, James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W 42nd St, New York 36, N. Y. See box, right, for directions regarding subscriptions or change of address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W 42nd St, New York 36, N. Y. Officers of the McGraw-Hill Publishing Company, Inc: Donald C McGraw, President; Joseph A Gerardi, Executive Vice-President; L Keith Goodrich, Vice-President and Treasurer; John J Cooke, Secretary. Officers of the Publications Division: Nelson L Bond, President; Shelton Fisher, Senior Vice-President; John R Callaham, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising Sales; A R Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of the power and plant services in utilities, consulting and contracting firms, industrial and service plants. Position and company connection must be indicated on subscription orders. Send to address shown in box, right.

United States subscription rate for individuals in the field of the publication $5.00 per year, single copies $1.00, unless otherwise indicated. Canada; $7.00 for one year. Foreign; $15.00 for one year. Second-class

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Power articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. Power publishes its own annual index, obtainable on request to the Editor. Notice of availability appears in Power.

SUBSCRIBERS: Send subscription correspondence and change of address to Fulfillment Manager, Power, 330 W 42nd St, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any (Official Post Office request). If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

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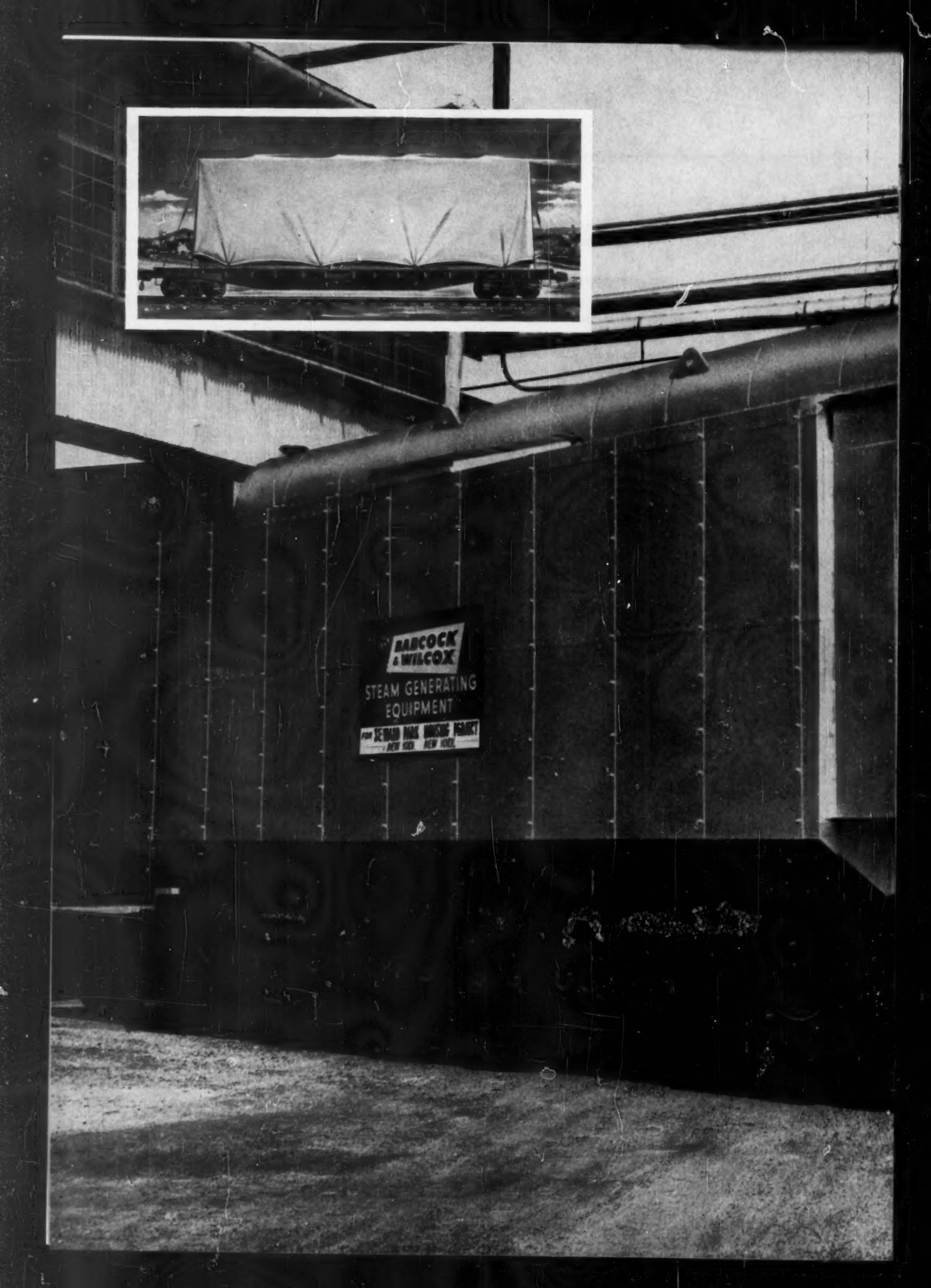

BABCOCK & WILCOX
STEAM GENERATING EQUIPMENT

Now: The Wraps Are Off

B&W's FO Package Boiler

This shop-assembled, B&W FO Package Boiler—being shipped as a single unit—is on its way to handle an important job.

The FO Boiler will supply all the steam to heat a new $22 million, 1728 family, cooperative apartment house in New York City. Simplicity of installation is only one of the FO Boiler's attractive features: just remove it from the flatcar or truck, make the necessary connections, and start it up.

This natural circulation boiler delivers up to 100,000 lb of steam per hour. It's B&W designed, to give you reliable high capacity with minimum maintenance in a small space. If you have a problem involving steam, B&W—with nearly a century of experience in the design and manufacture of steam generating equipment—will be delighted to help you. Just write to The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

G-951-1B

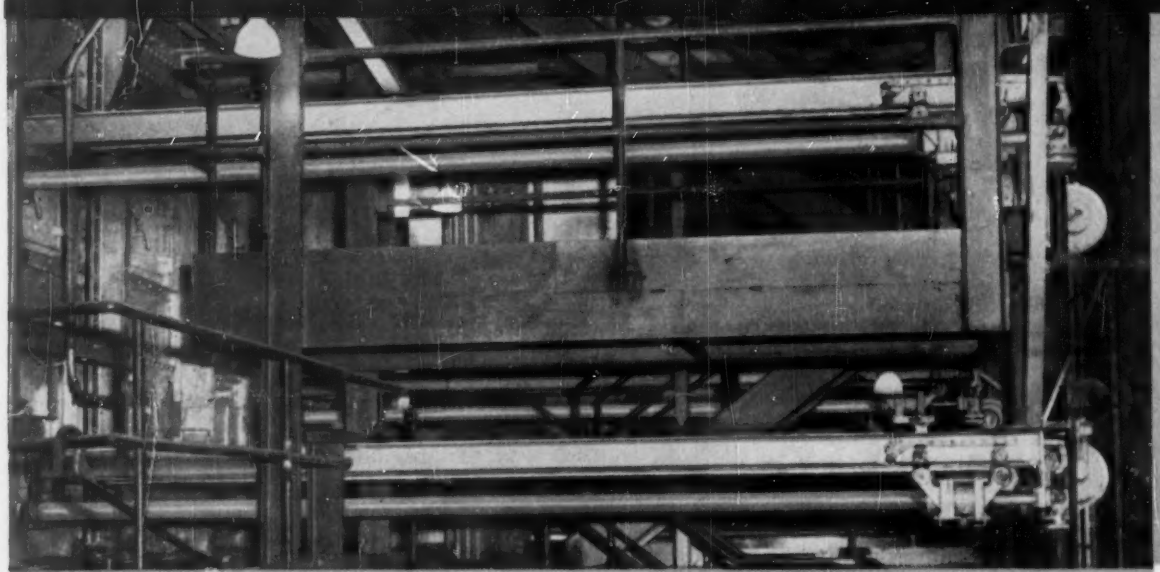
For more facts circle 205 on Reader Service card, p 101

AT F.M. TAIT STATION, DAYTON POWER & LIGHT CO.

BOILER CLEANING IMPROVEMENT HELPS MODERNIZATION PROGRAM

SAVE $40,000

DIAMOND BLOWERS and AUTOMATIC



Three of the Diamond Model IX Long Retracting Blowers installed to replace manually operated rotary blowers. Electric motor driven, they are controlled by the Automatic Sequential Panel. Air is used as the blowing medium. Rotary elements were retained in cooler locations and motorized for automatic operation and are also controlled by the Automatic Sequential Panel.

In the continuous struggle to cut operating costs, the Dayton Power & Light Co. has found a very useful tool in "Boiler Cleaning Modernization."

By applying the latest soot blowing equipment to four of their boilers at the F. M. Tait Station, together with other features of the modernization program, the Dayton Power & Light Co. was able to reduce the operating costs on these boilers by some $40,000 per year and also cut blower maintenance costs.

On the first boiler that had its cleaning modernized, 17 rotating elements were removed; the remaining seven blowers of this type were electrified for automatic control. The cleaning equipment added consisted of five Long Retracting Blowers and six Short Retracting Blowers. All blowers are automatically controlled by a Diamond Selectromatic Panel.

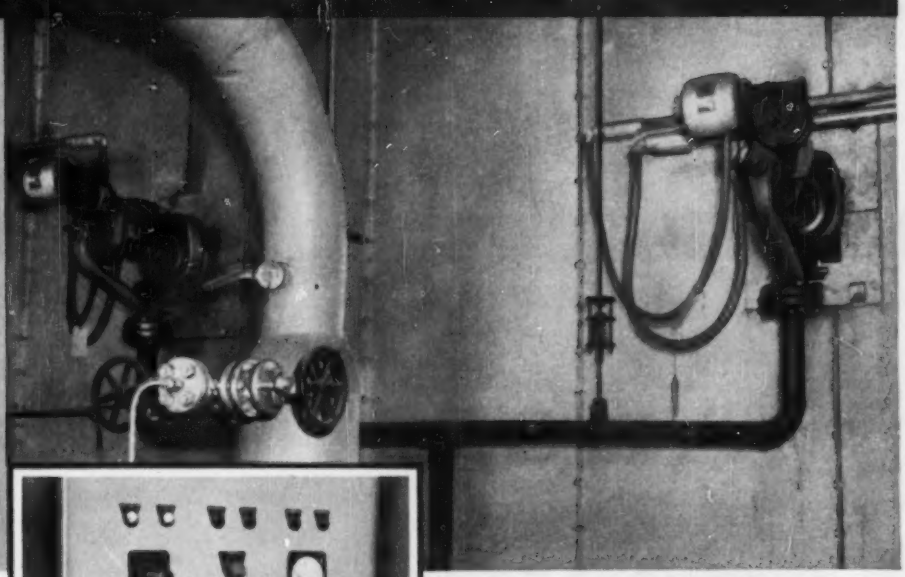
This is one of many examples of the savings possible by improvements now available in Diamond Blowers and Automatic Sequential Control. Over the years Diamond has engaged in continuous aggressive research in boiler cleaning. This research has paid off in improvements that save you money and improve your operation.

Let us make a study of your boiler cleaning . . . perhaps similar savings can be suggested.

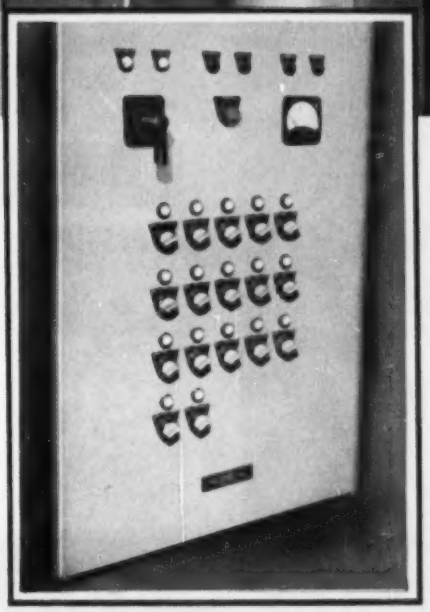
Per Year in Operation

and Cut Blower Maintenance Costs

SEQUENTIAL CONTROL PANEL



Two of the air blowing Model IR short retracting wall blowers with electric automatic operation.



Diamond Automatic Sequential Control Panel installed as part of the modernization program at the F. M. Tait Station. This panel automatically operates each blower in turn until the blowing cycle is complete. Any individual blower may be operated independently by simple turning switches. Cleaning program is set up by switches. Operator starts — thenceforth operation is automatic.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

8243

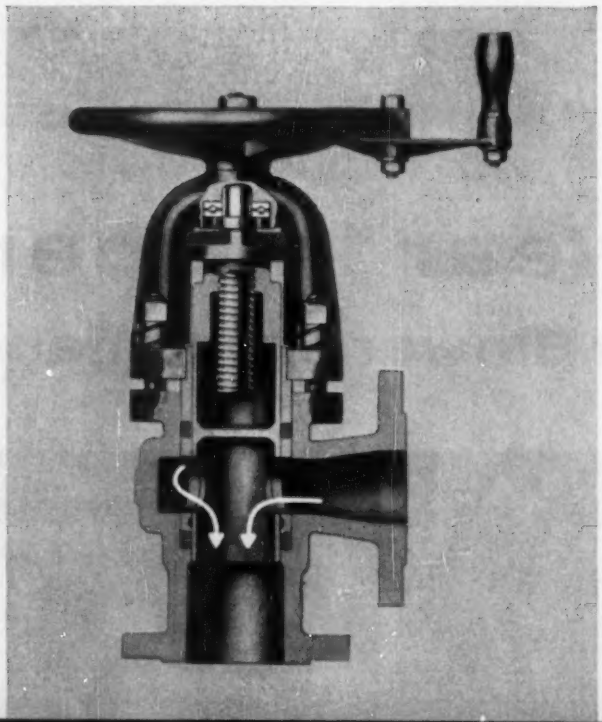
DIAMOND SPECIALTY LIMITED • WINDSOR, ONTARIO

For more facts circle 206 on Reader Service card, p 101

These YARWAY VALVE DESIGNS

YARWAY SEATLESS

Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



FOR LOW and MEDIUM PRESSURES

YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.

FOR HIGHER PRESSURES

USED IN OVER 15,000 BOILER PLANTS

serve every boiler blow-down need

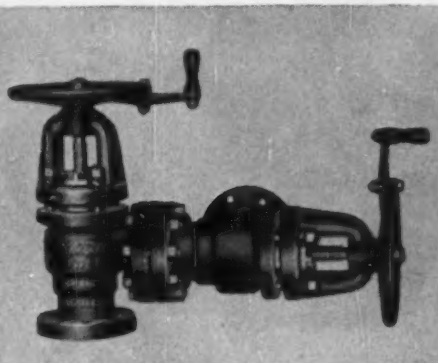
■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

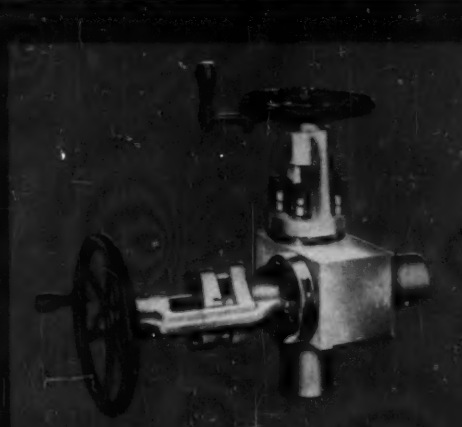
Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.



• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.



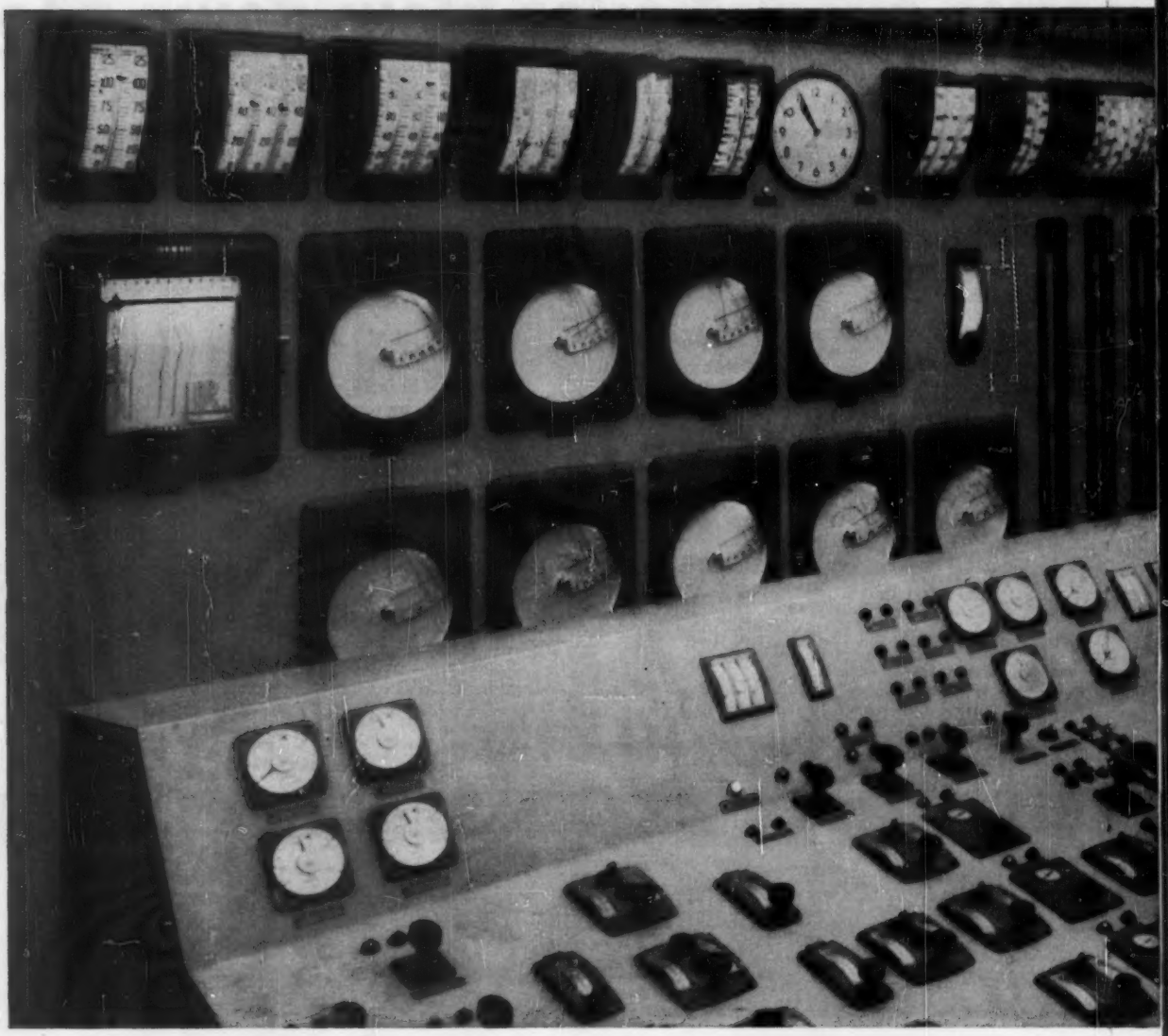
LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

blow-off valves

circle 207 on Reader Service card, p 101



How Bailey puts, at your finger

Concentrated, here, in one centralized control room are all the meters and controls needed to operate a Cyclone Furnace Boiler. Bailey puts them at your finger tips. Makes operating duties a pleasure. Increases plant efficiency.

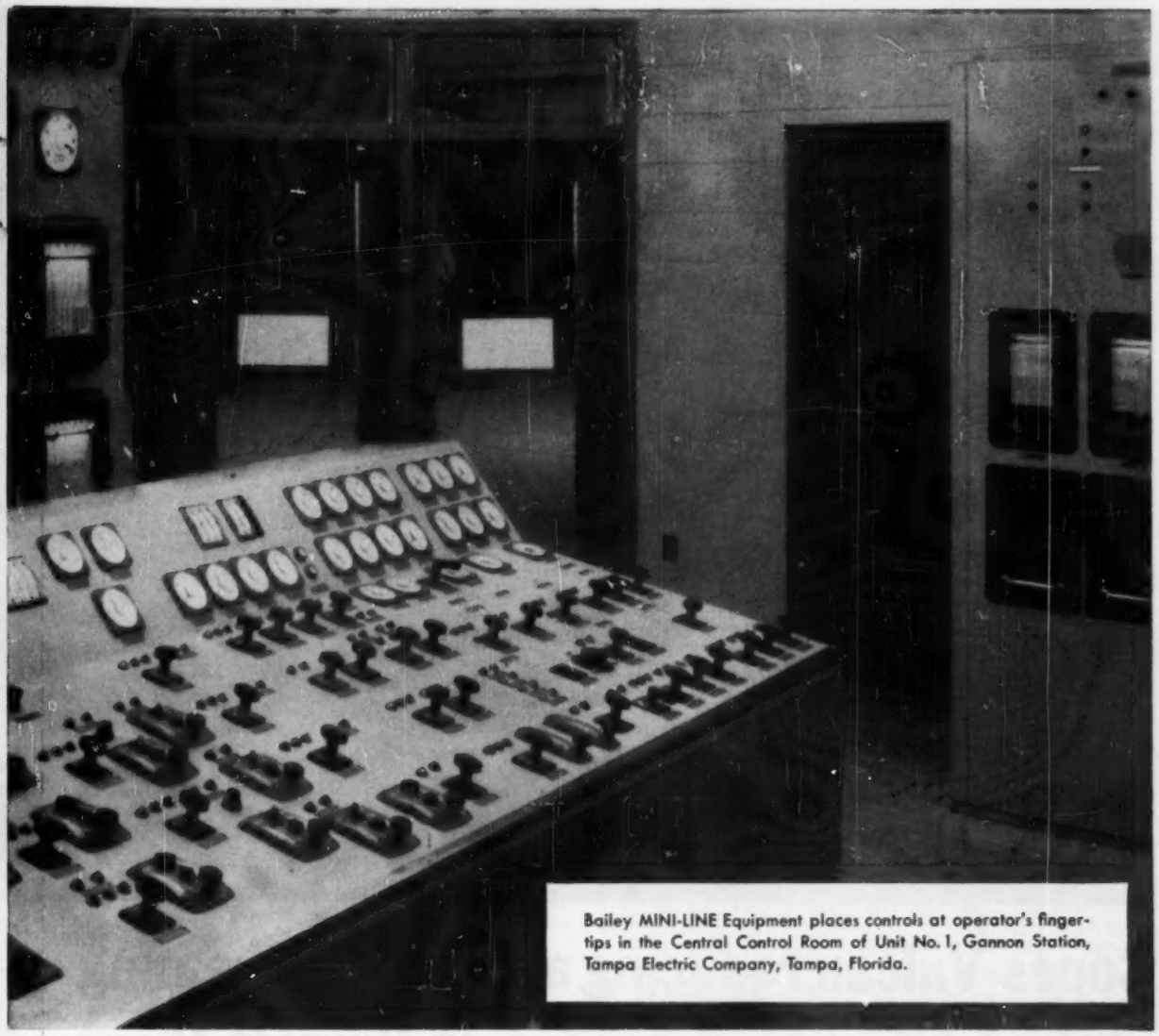
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems of measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work efficiently for more than forty years. Veteran engineer and young engineer alike, the men who



Bailey MINI-LINE Equipment places controls at operator's fingertips in the Central Control Room of Unit No. 1, Gannon Station, Tampa Electric Company, Tampa, Florida.

tips, controls for STEAM PLANTS

represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your particular problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A137-2

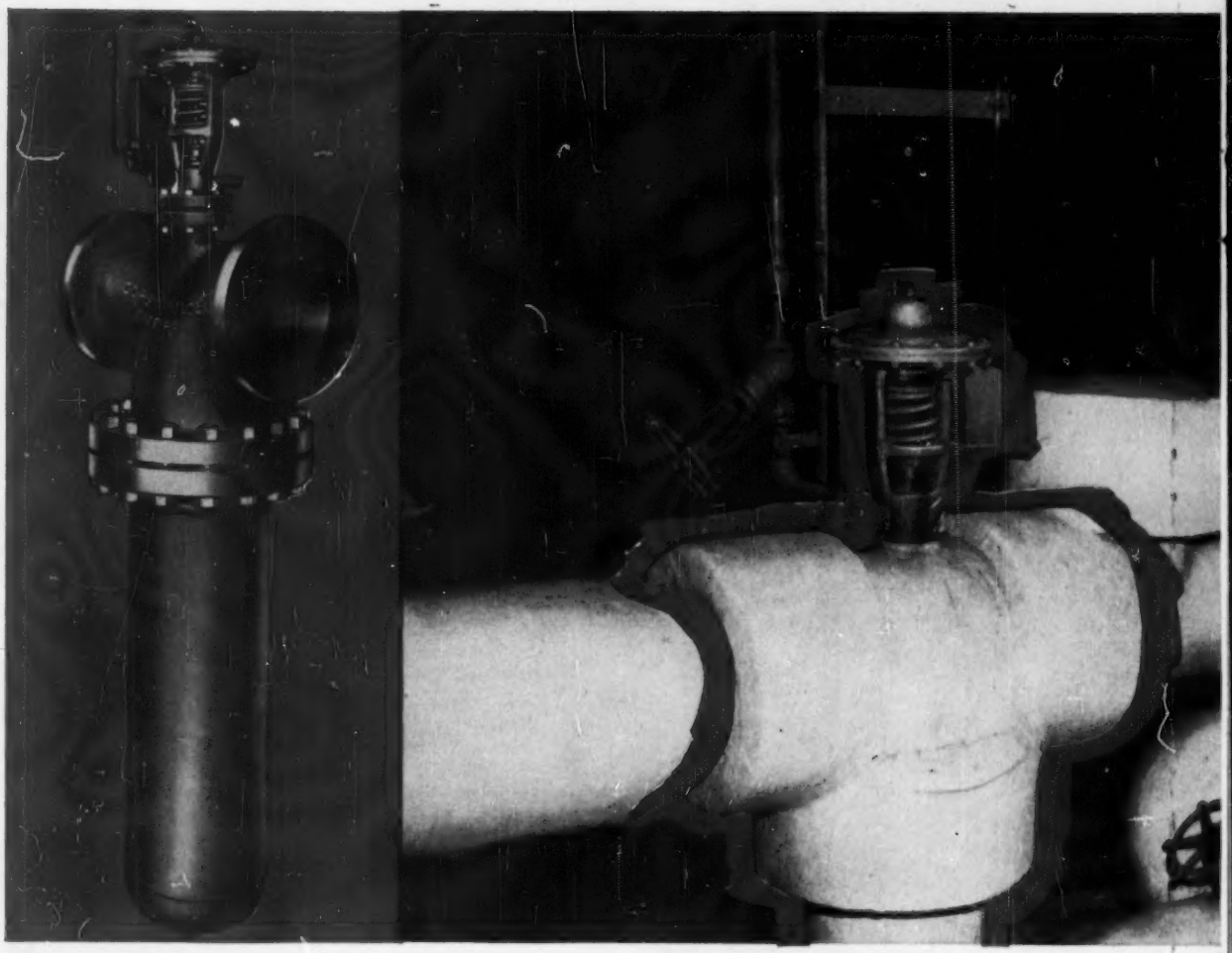
Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

For more facts circle 208 on Reader Service card, p 101



Copes-Vulcan reducing and desuperheating station takes load swings at Barrett Plant

Long Island Lighting Company uses a Copes-Vulcan desuperheating and pressure reducing station at their Edward F. Barrett Station. Steam is delivered to the reducing and desuperheating station at 2015 psig and 1005 F. Specifications require the station to condition flows of 500 to 25,000 pounds per hour down to 165 psig and 385-400 F. Maximum flow is 1000 pounds per hour in spring and fall, 3,000 pounds in winter.

During the evening hours in the winter, the generating unit comes down to half load or less, requiring the PR&D station to feed pre-heater steam coils. When the steam coils are supplied from the PR&D station the load swings from 3,000 to 17,000 pounds per hour in 30 seconds.

Made up of a Copes-Vulcan Carburetor-Type Desuperheater and a heavy service, piston-type valve, this station has provided trouble-free operation since its installation two years ago.

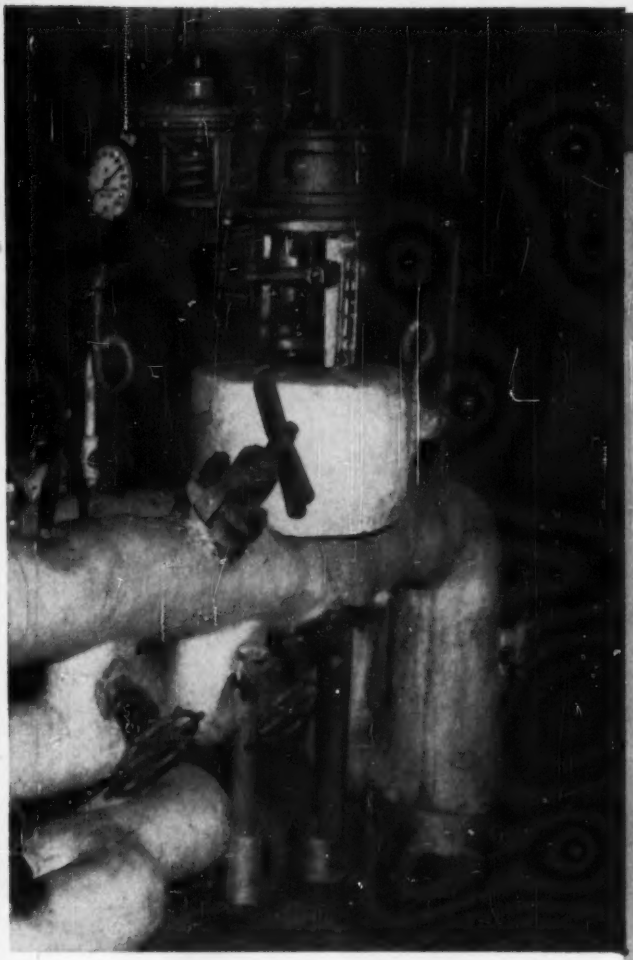
Besides the Carburetor-Type, Copes-Vulcan offers two other types of desuperheaters.

Steam-Assist Desuperheater has negligible permanent pressure loss on loads of 15% to 100% of maximum. This in-line desuperheater normally uses assisting steam only on light loads where control is most difficult. Write for Bulletin 1024-A.

Variable-Orifice Desuperheater holds reduced steam temperatures constant less than 20 feet downstream from desuperheater outlet over a 50-to-1 load range. Write for Bulletin 1037.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

BLAW-KNOX



Above—**3,000 TO 17,000 POUNDS PER HOUR IN 30 SECONDS** . . . That's the load swing handled by the Copes-Vulcan pressure reducing and desuperheating station during winter nights when steam coils are put into service.

Upper left—**CARBURETOR-TYPE DESUPERHEATER USED AT BARRETT STATION.** Superheated steam is directed to pass the spray nozzle, which injects cooling water into the steam before it enters the mixing chamber. The flow of cooling-water is controlled at the spray nozzle to maintain a pressure drop across the nozzle at all flows. Cooling-water spray entering the mixing chamber is instantly evaporated, thus lowering the steam temperature to that desired. Final temperature may be held within plus-or-minus 5°F.

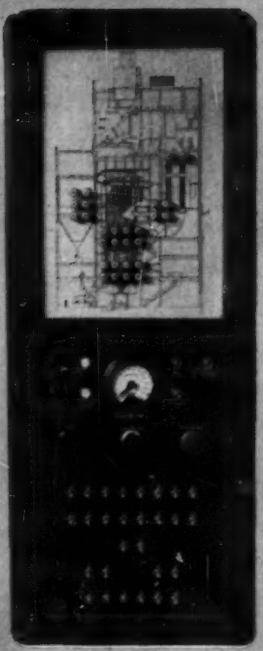
Available in standard 2" through 12" sizes, in 150- through 600-pound pressure standards for cast steel. Larger sizes and higher pressure standards are available on special application. Write for Bulletin 1056.

C-V NEWS NOTES

BARRETT STATION CONTROLS SOOT BLOWING on Unit 1 with a Vulcan Automatic-Sequential System. Vulcan Automatic-Sequential Control Systems can use steam, air, or a combination of both as the blowing medium.

Without leaving the panel, the operator can pre-select any number of units to be operated through automatic sequence, or individually . . . may reverse any soot blower at any point in its operating cycle . . . or switch from automatic-sequential to single-unit operation.

For details on Vulcan's complete line of automatic soot blowing stations, write for Bulletin 1029. (Panel shown gives automatic-sequential control for up to 60 soot blowers.)



PISTON-TYPE VALVES FOR PRECISION CONTROL of pressure, temperature, and liquid level. Piston actuation develops high forces to deal with static and dynamic unbalances, and with stuffing box friction. These valves meet rigid requirements for unusually high operating force and accurate positioning.

Copes-Vulcan also builds diaphragm-type CV-D Valves which may be direct- or reverse-acting. They offer excellent rangeability, and can be profitably applied to many jobs.

Both types available for pressure standards from 125 through 2500 pounds. Each valve is tailored to its job. For details, write for Bulletin 1027.

For more facts circle 209 on Reader Service card, p 101

Revere 90/10 Cupro-Baffles and

These exchangers will be exchanging heat between process water on the shell side and sea water on the tube side. Under these dual-corrosion conditions just any alloy would not be able to stand the gaff. That's why the engineers for Union Carbide Caribe specified Revere 90/10 Cupro-Nickel to do the job . . . 36,000 lbs. for the condenser tubes and 14,000 lbs. for the baffles and tube sheets.

Data indicated that Revere's 90/10 Cupro-Nickel would be satisfactory under the specific set of operating conditions which would be met in their installation in Ponce.

Because there are seldom two jobs with the exact same set of operating conditions Revere has found through its long and varied experience that fitting the alloy to suit the job is the best way to extend tube life to the maximum.

To find the alloy or combination of alloys best suited to meet a specific set of operating conditions, Revere offers the help of its Research Department, made available through the Technical Advisory Service.

Revere makes tubes and tube sheets in all the customary as well as special alloys. See the nearest Sales Office.

ONE OF THE 4 heat exchanger bundles which collectively accounted for 50,000 lbs. of Revere 90/10 Cupro-Nickel in the form of tubes, baffles and sheets.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

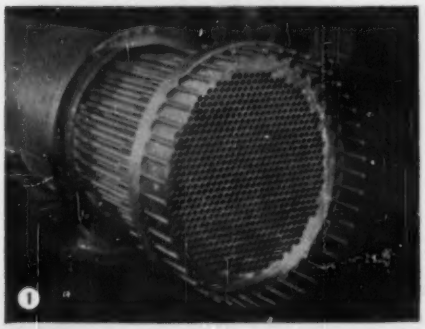
230 Park Avenue, New York 17, N. Y.

Mills: Rome, N.Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N.Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

Nickel Condenser Tubes, Tube Sheets

Fabricated into Heat Exchangers by
ENGINEERS and FABRICATORS, INC.

to be used in the Union Carbide Caribe's chemical plant in Ponce, Puerto Rico under tough, dual-corrosion conditions



(1) CLOSE-UP of one of the bundles that has been completely tubed and is ready for bolting into the shell.

(2) COMPLETED UNITS with channel heads in place and completely stacked ready for shipment to the Union Carbide Caribe Incorporated chemical plant in Ponce, Puerto Rico.

(3) HERE YOU SEE a section of the shop of ENGINEERS and FABRICATORS, INC., Houston, Texas, where the 4 heat exchangers were made.

For more facts circle 210 on Reader Service card, p 101

K&M ZEBRA

THE YEARS-AHEAD DEVELOPMENT IN PIPE INSULATION!

3 times faster to apply than 2-layer segmental insulation, new "K&M" ZEBRA is a multi-layer sectional-type thermal insulation for low, medium and high temperatures. And, it's as rugged as it is speedy. ZEBRA withstood repeated drops up to 8 inches without cracking...in increments of one inch. Bend it...and there's no cracking. (Its deflection at breaking point is 2 to 4 times that of ordinary insulation.) That's why breakage during installation practically disappears. There's a new ease of handling, too. No skin irritation. No skin penetration by ragged projections. "K&M" ZEBRA is smooth-surfaced. Get more information on this exciting, new development in pipe insulation. Write to us today for more information.

• For temperatures of 200°F. to 1200°F. • Withstands shock and heat without warping or cracking. • Made of calcium silicate—asbestos fiber bonded felts. • Can be re-used . . . can be dismantled and re-applied. • Available in wide range of sizes and thicknesses. • Tested by an independent testing laboratory.

K·M
BEST IN ASBESTOS

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

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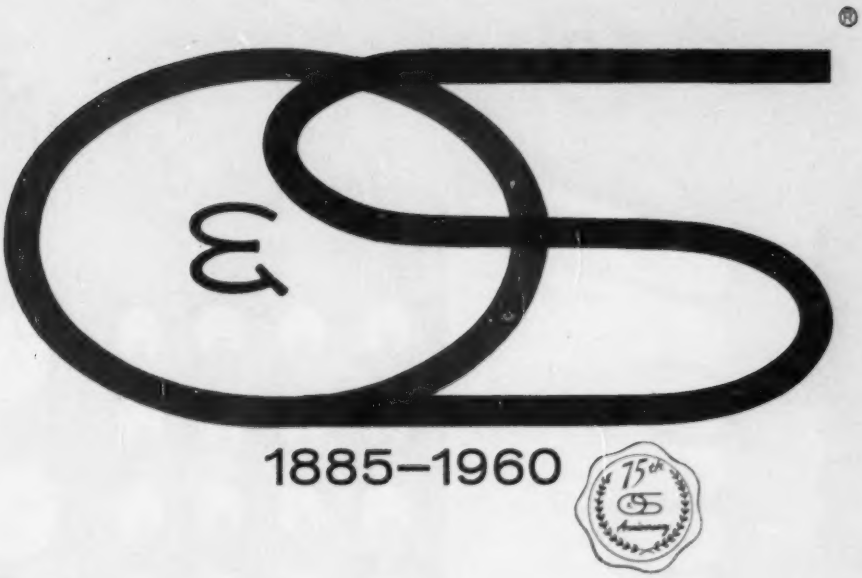

An Anniversary... and a Promise

For 75 years this company has been building boilers.

We are grateful for the skills and sense of responsibility of our engineers and craftsmen, working in the solid tradition of one of America's first metalworking centers. They have met the needs of industry through the years, and developed O&S products to a high degree of reliability and performance.

We don't feel old. We feel younger and more capable than ever, and we make this promise to our friends and customers: We will never rest in our efforts to produce the finest, most advanced boilers and fuel burning systems that it is possible to build.

A. W. Klein
President

ORR & SEMBOWER, INC.
850 Morgantown Road, Reading, Pa. • Since 1885

Powermaster® PACKAGED BOILERS

O&S FUEL BURNING SYSTEMS

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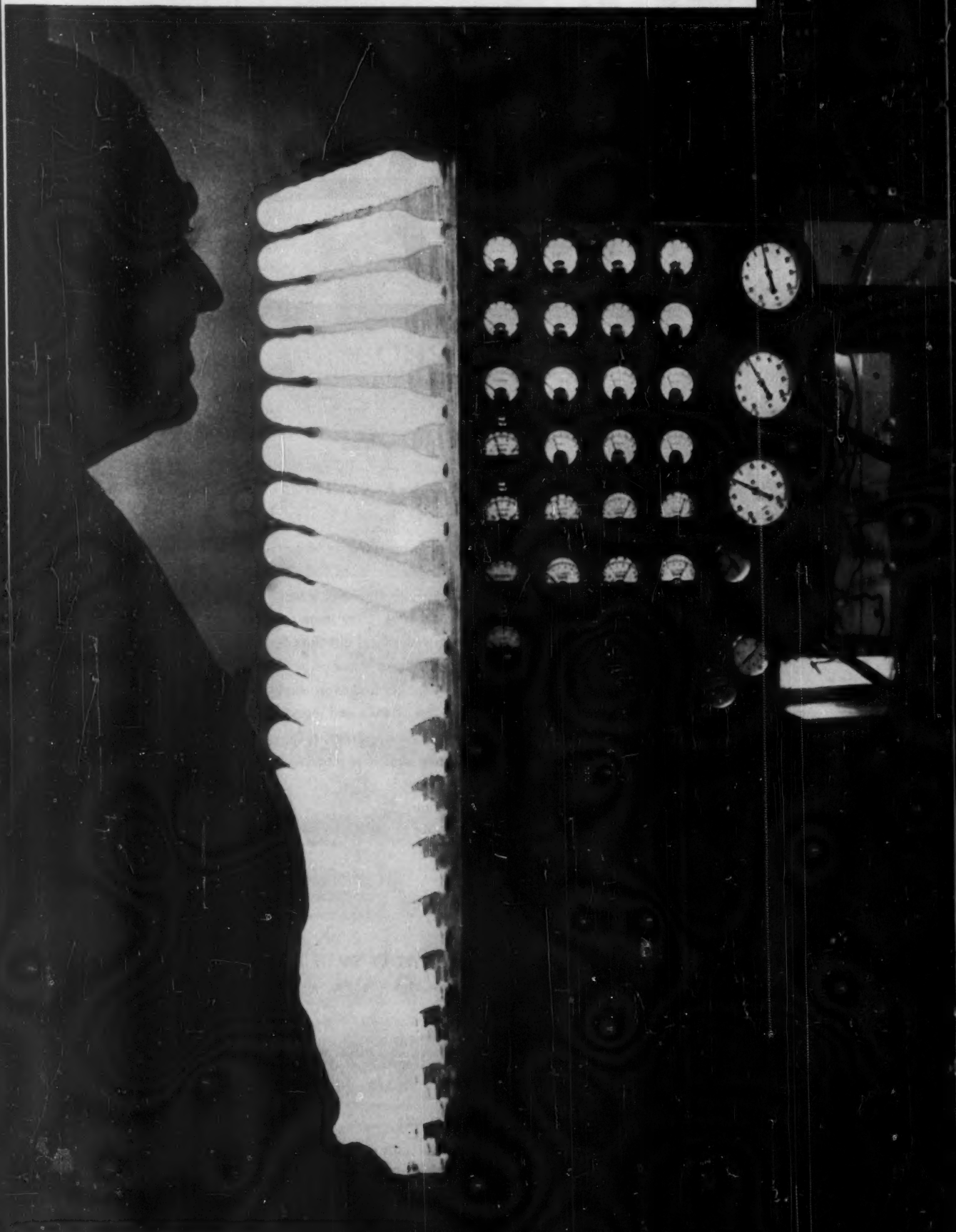


View of Avco-Everett laboratory's experimental magnetohydrodynamic (MHD) power generator as it successfully lights a bank of 228 50-watt bulbs for the first time. The device already has produced more than 10,000-watt output and represents a first step in application of the MHD theory to generation of commercial electric power.

Ten power companies join Avco in research program to develop new electric power generation system

Ten leading power companies have joined with AVCO in a research and development project which could revolutionize the nation's electrical power industry and effect a 25 per cent increase in operating efficiency.

Key to the project is the elimination of the turbine generator in power generation cycles.

The new power system is based on the scientific principle of magnetohydrodynamics (MHD). A small experimental laboratory device, utilizing the MHD principle to generate electric power, is currently operating at the Avco-Everett Research Laboratory.

The utility group joining with AVCO includes Appalachian Power Company, Central Illinois Light Company, Dayton Power and Light Company, Illinois Power Company, Indiana & Michigan Electric Company, Indianapolis Power and Light Company, Kansas City Power & Light Company, Louisville Gas and Electric Company, Ohio Power Company, and Union Electric Company.

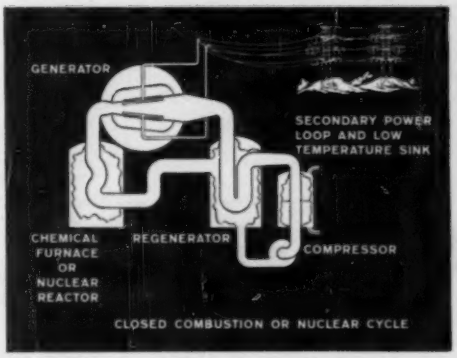
The 10-company utility group will be represented by American Electric Power Service Corporation, a subsidiary of American Electric Power Company, as agent in carrying out the joint venture with AVCO.

WHAT IS MHD?

Magnetohydrodynamics—MHD—is the study of the interactions between a magnetic field and a superheated, ionized gas. Magnetohydrodynamic studies have long been conducted by personnel of Avco-Everett Research Laboratory. AVCO scientists first began work in the MHD field in connection with space propulsion and successful re-entry from outer space. As a result of these studies came the first indications that it might be possible to produce electricity for utility application.

At sufficiently high temperatures, gases become ionized; that is, the atoms of the gas tend to lose one or more of the electrons which circle the atomic nucleus. When electrons are lost, the atom becomes a positively charged ion.

An ionized gas will conduct electricity. An ionized gas passing through a magnetic field will generate electricity. This is because the gas is an electrical conductor and acts like the armature which passes through a magnetic field to generate electricity in a conventional power plant. In a conventional electric plant a solid coil of wire, the armature, passes through a magnetic field to produce electricity. In the MHD generator a superheated, ionized gas is substituted for the armature, eliminating much of the heavy and costly equipment of a conventional system.



System chart shows magnetohydrodynamic commercial power generation cycle. Chemical furnace or nuclear reactor (lower left) heats and ionizes working gas, which then flows through magnetic field in the MHD generator. Direct current is tapped off the ionized gas by means of electrodes in the generator. Gas is then cooled in regenerator and heat sink, compressed and preheated in regenerator prior to re-entering furnace for heating and ionization.

AVCO CORPORATION / 750 THIRD AVENUE, NEW YORK 17, N. Y.

Avco

For more facts circle 213 on Reader Service card, p 101

ENGINEERED PRODUCTS

for Plant Maintenance

PROTECT EQUIPMENT FROM DAMAGE DUE TO HIGH PRESSURE, TEMPERATURE

Now, more than ever, plant engineers and maintenance men specify Garlock PK MECHANIPAK* Seals, LATTICE-BRAID* Asbestos Packings and GUARDIAN* Gaskets for safe, long lasting prevention of equipment failure due to high pressures and temperatures.

Garlock PK MECHANIPAK Mechanical Seals are easy to install and maintain. They are completely self-contained . . . no parts to put together. Rotating portion simply slides onto shaft; stationary portion positions quickly. Once installed, further adjustment is unnecessary. No parts of the seal move on the shaft or sleeve, eliminating wear on the shaft. Available in shaft sizes from 3/8" to 3" . . . operate at temperatures to 212°F, pressures to 150 psi, shaft speeds to 2000 fpm. Catalog AD-150.

Garlock LATTICE-BRAID Packings are engineered for longer packing life. They employ a through-and-through braiding construction. As illustrated above, each strand passes diagonally through the packing at a 45° angle. This unique construction makes a completely unified structure, resulting in greater strength. Since there is no single outer braid to wear through, Garlock LATTICE-BRAID will wear far beyond the limits of ordinary packings. Applicable against water, steam, oil, gases and chemicals to 700°F. Catalog AD-131.

Garlock GUARDIAN Gaskets provide a safe, positive seal against high temperatures and pressures of steam, oils, gases, liquids. Construction assures dependable sealing under varying service conditions. Strips of V-shaped metal, alternated with layers of asbestos or Teflon†, are spiral wound to form the gasket. A predetermined density is introduced into the gasket to satisfy application requirements. Used at temperatures to 1050°F, pressures to 2500 psi . . . available in round, oval, square, flat side, diamond, pear and other shapes in practically any size. Catalog AD-104.

GARLOCK

For more information, contact the nearest of Garlock's 26 sales offices and warehouses throughout the U.S. and Canada. Or, write for catalogs. The Garlock Packing Company, Palmyra, New York.

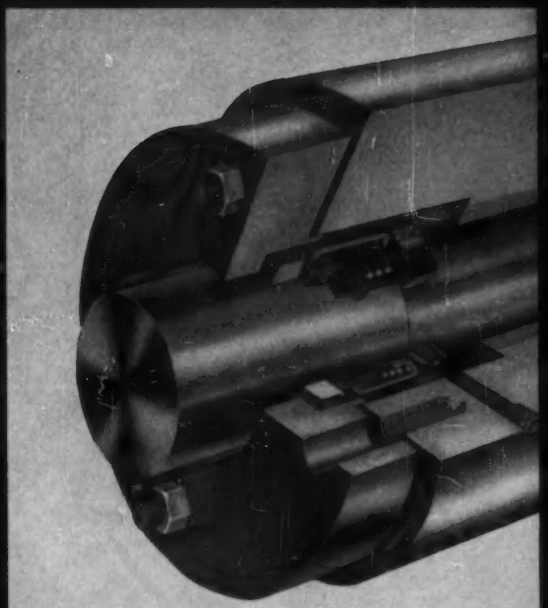
Canadian Div.: The Garlock Packing Company of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded & Extruded Rubber, Plastic Products

*Registered Trademark
†DuPont Trademark for TFE Fluorocarbon Resin

For more facts circle 214 on Reader Service card, p 101



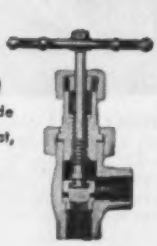
PK MECHANIPAK Mechanical Seals are self-contained, can be installed simply and quickly, eliminate adjustment during operation. Offer leak-proof sealing without shaft wear.

LATTICE-BRAID Packing lasts far beyond the limits of other packings . . . once installed, rarely requires further gland adjustment. Gives maximum service life over a wide range of temperatures, pressures. Only Garlock can give you LATTICE-BRAID.

GUARDIAN Gasket V-shaped metal plies have an automatic spring action that reacts to variations in compression, internal pressures, and temperature changes. Assure leak-proof seal under most severe conditions.

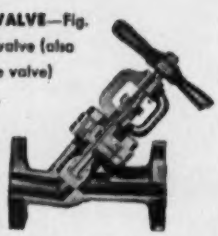
EDWARD FIG. 848
GLOBE VALVE
ILLUSTRATES
VALVE SELECTION PRINCIPLES

1 ANGLE VALVE—Fig. 2699, 600 lb at 900F (2000 lb WOG) with union bonnet, inside screw, replaceable seat, knobbed handwheel, and screwed ends. Sizes ¼" to 1".



2 UNIVALVE®—Fig. 2224, 1500 lb. at 1050 F (3600 lb WOG) or 2500 lb at 1050 F (6000 lb WOG) with outside screw, Impactor® handle seal-welded bonnet, integral seat and socket welding ends. Sizes to 2½".

3 BLOW-OFF VALVE—Fig. 641, straightway valve (also available as angle valve) 300 lb at 850 F, 600 lb at 850 F, 1500 lb at 850 F, with integral Stellite seat, flanged ends, bolted bonnet. Sizes to 2½".



What's New from Edward Valves

New Products . . . Solutions to Problems . . . Information on Steel Valves from Edward, Long-Time Pioneer in the Field!

HOW TO SELECT FORGED STEEL VALVES

When you need forged steel globe or angle valves (2½" and smaller) for high-pressure and/or high-temperature applications, you can save money on your installations as well as reduce future maintenance expense by making sure you select the proper valve. Here are a few suggestions.

VALVE CONSTRUCTION DETAILS
(See large illustration, opposite page)

Valve Handwheel or Handle should be large enough to operate valve easily. Wheel spokes help keep handwheel cool. Knobbed design permits tight grip even with greasy gloves. Impact type handle will be helpful in obtaining tight closure for valves 1½ to 2½ in.

Yoke Bushing material should be checked. High-strength aluminum bronzes are usually best. Look for ample thread engagement between bushing and yoke and between bushing and stem.

Gland-Stuffing Box—Stuffing box with bolted gland assures good packing compression; hinged bolts swing out of the way but don't get lost. Be sure to get stainless steel bolts for maximum resistance to rusting, and for easy adjustment even after years of service. Packing chamber should be deep and not excessively wide.

Bonnet Joint of bolted construction is easiest to work with. You can disassemble and reassemble with pocket-size tools. Union bonnet is compact and usually less expensive for smaller valve sizes, but is not recommended for high temperatures. Bonnet gasket of soft iron performs well in most services but spiral wound metallic-asbestos gaskets are superior in high temperature services. For extreme pressure-temperature services welded bonnet joints for permanent tightness are desirable. Seal-welded type bonnet has advantage over fully welded design because it permits disassembly and reassembly.

Seat-Disk Joint—An integral hard-faced seat is generally regarded as superior to screwed seat construction because it eliminates body-seat leakage and retains hardness under temperature. A hard faced disk or disk of special alloy is desirable in high temperature services; but 13 per cent chromium stainless steel is an excellent all purpose material below 750 F.

Other Features to Evaluate—Valve compactness is important because you frequently find small piping located in crowded quarters. Inclined bonnet globe valves are less likely to erode due to high velocities—have less pressure loss. Valves of "inside screw" design (stem threads below packing chamber) are usually lower priced and give good service where temperature is not too high and where line fluids are free of sediment. But, best design and materials are useless without experienced workmanship and rigid quality control.

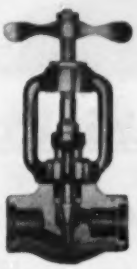
VALVE APPLICATION SUGGESTIONS

First, determine whether a standard valve will do the job before ordering expensive special designs. (Your Edward Representative can help you decide.) Often a slight modification of a standard valve, or a combination of standard valves, will do the job. Here are some facts about types of standard valves and their application:

- For many services, angle valves (illustrated by valve #1) reduce installation cost, minimize pressure drop, improve operational convenience. All Edward forged steel stop and stop-check valves from ¼" to 2½" sizes are available in the angle version.
- For high temperature, Edward forged steel valves with seal-welded bonnets (#2) permanently maintain pressure tightness without periodic tightening of bonnet joints.
- For blow-off service, or wherever double valving is required, select sets of valves of the same basic type with hard-faced seating surface for dependability, longer life and interchangeability of parts (#3).
- For permanent tightness, select an instrument valve (#4) with corrosion-erosion resistant hard-faced seat or a valve with stainless steel body. Bonnetless design requires less maintenance.
- Piston-type check valve (#5), available with union, bolted, or seal-welded cover, is best for most services because it will seat tighter, has easily repairable seat face.
- Modern globe and angle stop valves (shown here) are more dependable than gate valves where repeated drop-tight closures are required, may be used for approximate flow regulation and moderate throttling.

YOUR EDWARD REPRESENTATIVE will be glad to give you the complete story on these features, plus the many other advantages of Edward valves—such as positive, pressure-tight backseats, self-centering disks, special stem and packing materials, and many others. Edward builds a complete line of cast and forged steel valves for pressures to 10,000 lbs. For additional information write to Edward Valves, Inc., 1230 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame St., W., Montreal 1, Quebec.

4 INSTRUMENT VALVE—Fig. 952Y, 600 lb or 2500 lb at 850 F (6000 lb WOG) with swing bolted gland, socket welding ends, no bonnet joint. Sizes ¼" to 1".



5 CHECK VALVE—Fig. 5538, piston type, 1500 lb at 1050 F (3600 lb WOG) bolted bonnet, screwed ends, integral Stellite seat. Sizes ¼" to 2".

*T. M. Reg. U. S. Pat. Off.

EDWARD STEEL VALVES
another fine product by
ROCKWELL

Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs. with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

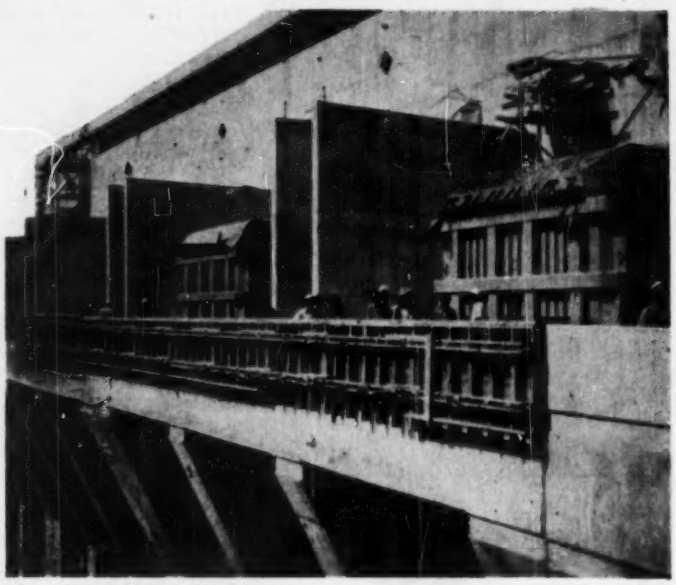
HITACHI

Casing for 150,000 HP Francis Turbine for the Bhakra Power Station, India.

Another Big Power Project for Hitachi

When the Government of Punjab, India, called for international tenders for the big Bhakra Dam Power Plant No. 1, to consist of five complete sets of generating equipment, Hitachi was awarded a contract for five 150,000 HP hydraulic turbines in the face of spirited competition.

The output of these turbines was originally planned to be 125,000 HP but it was decided to increase this to 150,000 HP (112,000 KW) at the normal head of 400 feet (122 meters) in view of the capacity of the generators. These are rated at 100,000 KVA and 0.9 power factor, and capable of continuous operation under a 15% overload. At the maximum head of 512 feet (156 meters) the turbines can deliver 200,000 HP but their output over the normal head will be limited to 150,000 HP to co-ordinate their capacity to that of the generators.



Hitachi, Ltd.
Tokyo Japan

Cable Address: "HITACHY" TOKYO

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US RUBBER EXPANSION JOINTS

How to keep your cost accountant contented

Just ask him to amortize the cost of a U.S. Rubber Expansion Joint.

He will have a pleasant time discovering that these joints never seem to wear out. Some have been in use for 30 years and are as sturdy as ever. No other rubber expansion joints have been in use that long.

"U.S." Expansion Joints are the only joints that have withstood this test of time. As for value, "U.S." Expansion Joints remain the cost accountant's delight. Other so-called "just-as-good" joints costing a few dollars less can rob you of many times their complete cost when they cause downtime.

Your accountant will tell you that "U.S." Expansion Joints comprise shrewd, logical insurance. These joints are the economical, flexible connections used in all kinds of pipe lines to take care of misalignment, vibration, expansion, contraction and noise transmission. No moving parts to wear or bind; can be installed on new or old equipment.

• • •

When you think of rubber, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

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WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

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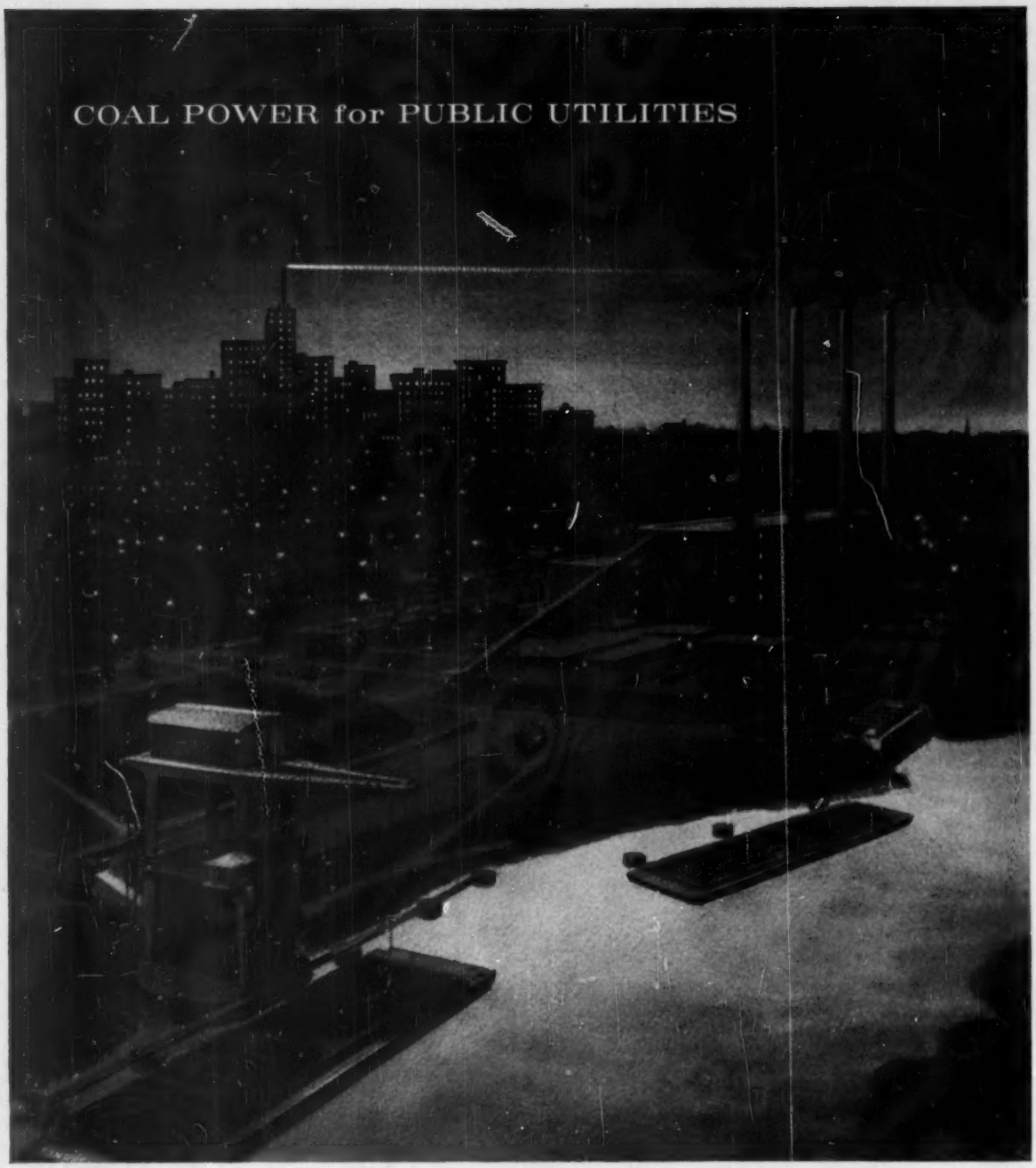

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POWELL

world's largest family of valves

Fig. 1365A—Small Steel Pressure Seal "Y" Check Valve for 1500 pounds W.S.P. Socket weld ends. Sizes ¼" to 2". Also available for 2500 pounds in sizes ½" to 3".

Fig. 3061A WE—Newly designed Steel Swing Check Valve for 300 pounds W.S.P. Has straight flow through area when disc is in wide open position.

Fig. 1130S—Steel Pressure Seal Gate Valve for 1500 pounds W.S.P. The higher the pressure within the valve the tighter the seal at body-bonnet joint. 600, 900, 2500 pound valves can be furnished.

Fig. 9003 WE—Steel Gate Valve for 900 pounds W.S.P. Outside screw rising stem and yoke. Solid wedge disc. Steel valves are available for pressures from 150 through 2500 pounds.

Fig. 512—Small Bronze Gate Valve for 150 pounds W.S.P. Inside screw non-rising stem. Solid wedge disc. Can also be supplied with flanged ends.

Fig. 1444—Large Iron Body Bronze Mounted Gate Valve for 125 pounds W.S.P. Outside screw rising stem and yoke, double wedge disc. Also available with solid wedge disc.

NO MATTER WHAT your flow control requirements, Powell offers more kinds or types of valves, available in the largest variety of metals and alloys. Powell distributors, located in all principal cities, maintain inventories to fill almost any need. For special engineering problems, write direct to:

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

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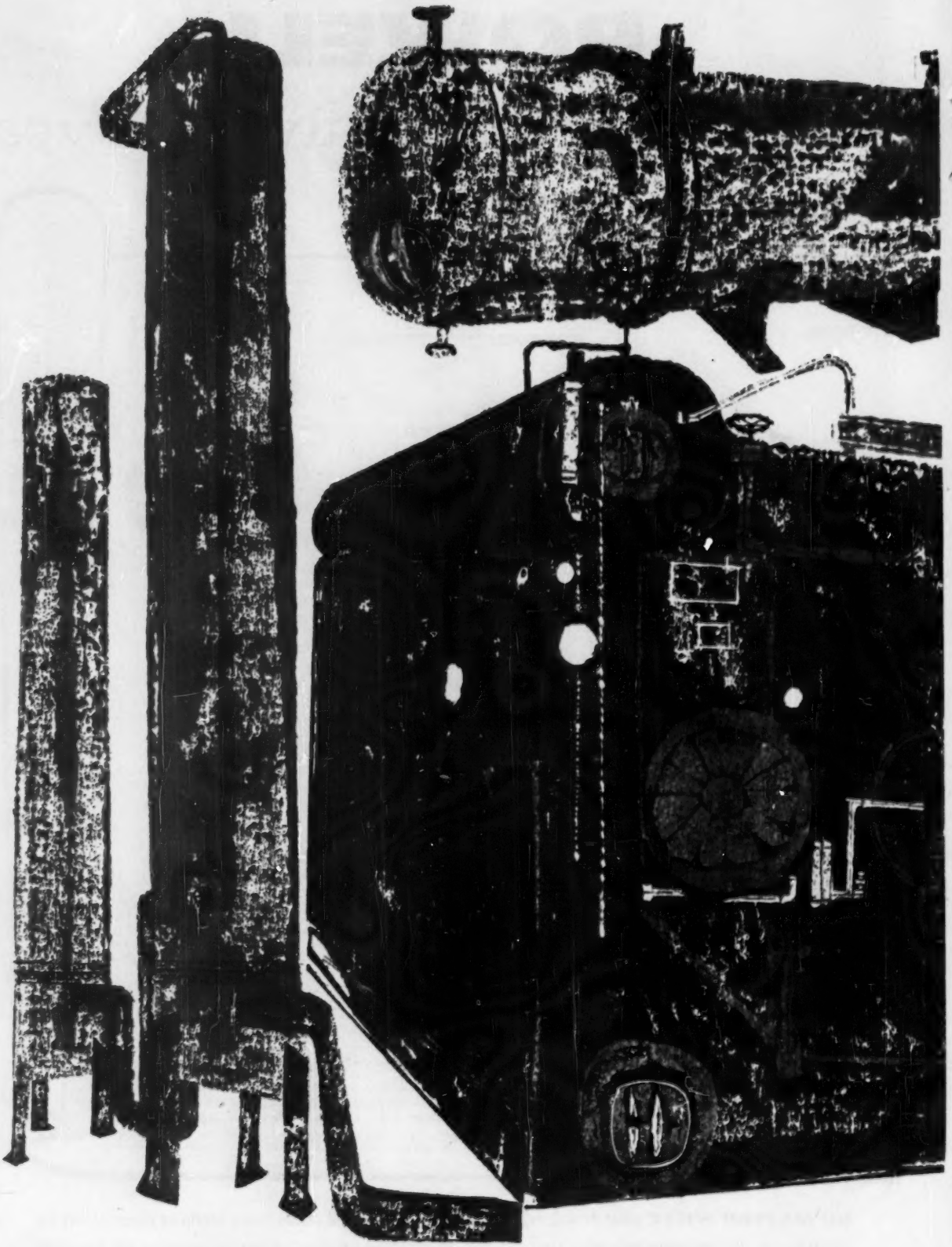

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Central Station and Industrial Steam Generators • Steam Condensers and Pumps • Pulverized Fuel Systems • Feedwater Heaters • Packaged Steam Generators • Cooling Towers • Nuclear Components

You don't pay for this extra...

At Foster Wheeler *extra thoroughness* is standard procedure. FW engineers are more than just designers and builders of equipment. They are also men with experience in the overall application, operation and servicing of power plant equipment. In knowing a little more about the whole plant, they are better able to produce efficient, rugged, easy-to-operate equipment.

This *extra thoroughness* also refers to the conscientious work of FW shop men and technicians who are familiar with equipment end-use. They never forget that operating conditions are often more severe than those created in standard shop tests.

And this *extra thoroughness* is further demonstrated in the training and supervision of the people responsible for product design and fabrication.

The result... better engineered and better built power plant equipment! Prove this to your satisfaction by addressing an inquiry to Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.

For more facts circle 220 on Reader Service card, p 101

1959 TOWER TESTS

Show Marley's Plus Performance Value

Here is the RECORD OF PERFORMANCE . . . consecutive results of all acceptance tests of Marley industrial Cross-Flow cooling towers made in 1959. This tabulation certifies Marley's ability to rate towers correctly and its single-minded purpose of applying them exactly as rated. Here are factual reports from 27 Marley installations in all parts of the country. Their specified capacities, operating conditions and types of service are as diversified as their geography, but tests uniformly emphasize the fact that these customers received a performance bonus that points up Marley Cross-Flows as vital investments in plant capacity and operating efficiency.

TEST NO.	TYPE OF SERVICE AND LOCATION	SPECIFIED CONDITIONS				TEST RESULT[4]	
		Gallons Per Minute	Hot Water Temp.	Cold Water Temp.	Wet Bulb Temp.	Degrees Cold Water Temp.[5]	Percent Capacity
1[1]	Generating Station—Mid-Atlantic	220,000	97°	78°	70°	+0.35°	+ 3.5%
2	Petroleum Refinery—Gulf Coast	3,500	95°	83°	70°	+ .47°	+ 4.0%
3	Generating Station—Southern	20,000	100°	85°	78°	+ .19°	+ 1.9%
4	Generating Station—Rocky Mtns.	89,300	95°	82°	60°	+1.88°	+ 9.75%
5[2]	Generating Station—S. Atlantic	75,000	113°	90°	74°	+ .20°	+ 1.25%
6	Petroleum Refinery—Gulf Coast	8,600	105.8°	87°	82°	+ .45°	+ 5.8%
7	Appliance Mfg. Plant—E. Central	7,750	95°	85°	78°	+ .40°	+ 5.00%
8[2]	Petroleum Refinery—Gulf Coast	45,000	112°	89°	82.5°	+ .72°	+ 6.65%
9	Generating Station—Mid-Central	62,400	107.5°	90°	76°	+1.10°	+ 7.3%
10	Petroleum Refinery—N. Atlantic	12,900	115°	85°	78°	±0.00°	± 0.0%
11[2]	Meat Packing Plant—North Central	6,000	105°	85°	75°	+ .60°	+ 5.2%
12	Jet Engine Plant—South Atlantic	20,000	95°	85°	79°	+ .40°	+ 6.0%
13	Generating Station—Gulf Coast	65,000	104.6°	87°	76.5°	+ .45°	+ 3.3%
14[2]	Petroleum Refinery—Gulf Coast	17,500	111°	90°	80°	+ .47°	+ 3.5%
15[2]	Petroleum Refinery—North Central	4,150	110°	75°	68°	− .10°	− 0.6%
16	Petroleum Refinery—East Central	19,400	120°	85°	75°	+ .65°	+ 5.5%
17[2]	Petroleum Refinery—Gulf Coast	57,500	120°	85°	79°	− .17°	− 1.3%
18	Petrochemical Plant—Gulf Coast	15,000	115°	90°	78°	+ .70°	+ 5.3%
19[2]	Air Conditioning—Mid-Atlantic	3,600	95°	85°	78°	+ .70°	+12.6%
20[2]	Atomic Test Facility—North West	70,000	112°	87°	65°	+1.50°	+ 5.9%
21	Chemical Plant—Gulf Coast	1,350	155°	86°	81°	+ .10°	+ 1.4%
22	Air Conditioning—Gulf Coast	7,000	93.5°	86°	80°	+ .30°	+ 6.0%
23[3]	Petroleum Refinery—Central	60,000	120°	80.6°	70°	+ .25°	+ 1.84%
24	Paper Mill—South Central	10,000	116°	86°	79°	+ .05°	+ 0.25%
25	Air Conditioning—South Central	6,000	105°	85°	78°	+ .25°	+ 2.7%
26	Generating Station—Mid-South	38,000	103.2°	90°	80°	+ .70°	+ 5.4%
27	Generating Station—West Coast	34,000	96°	80°	70°	+ .42°	+ 3.75%

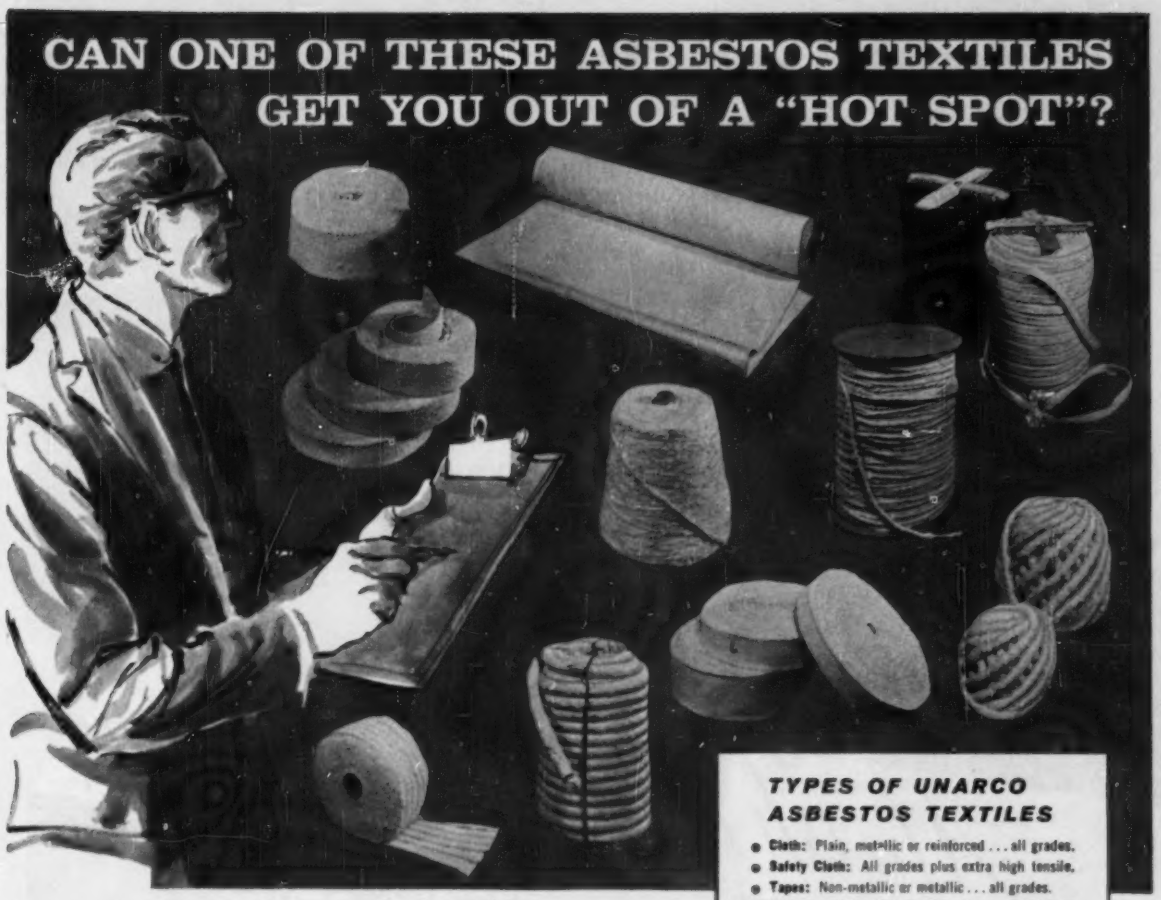
NOTES: 1) Total capacity four identical towers: results are average of tests conducted on two towers. 2) Cooling Tower Institute observer present during tests. 3) Test of tower remodeled to increase performance after more than 13 years of service. 4) Test results are adjusted to specified conditions. 5) + indicates lower cold water temperature than specified; — indicates higher cold water temperature than specified.

"TEST YOUR TOWER"—a brochure that details the Marley method of tower testing, and "ANALYZE YOUR BIDS"—one that presents a logical means of pre-purchase evaluation, should be in every engineering library. Your Marley engineer will gladly furnish copies or just send a request to

THE MARLEY COMPANY MARLEY **KANSAS CITY, MISSOURI**

For more facts circle 221 on Reader Service card, p 101

CAN ONE OF THESE ASBESTOS TEXTILES GET YOU OUT OF A "HOT SPOT"?



largest selection of asbestos textiles anywhere

It's the high quality Chrysotile asbestos that puts the "muscle" in UNARCO Asbestos Textiles and with this strength and toughness comes superior resistance to heat. No particular secret about it. UNARCO just combines skillful fiberizing, blending, carding, spinning and weaving to offer you the highest quality asbestos textiles at competitive prices.

UNARCO presents a long lineup of textiles from which to pick and choose in a considerable variety of styles, textures, weights and thicknesses. Check the list at right. Which one of these specialized textile products can help you? Or do you have need for a special product that we can develop for you? Whatever your requirements, UNARCO specialists will work with you to meet your needs completely.

TYPES OF UNARCO ASBESTOS TEXTILES

- **Cloth:** Plain, metallic or reinforced . . . all grades.
- **Safety Cloth:** All grades plus extra high tensile.
- **Tapes:** Non-metallic or metallic . . . all grades.
- **Woven and Braided Tubing:** Plain, metallic or neoprene coated or metallic . . . all grades.
- **Lap:** Available in 3 Underwriter's grades.
- **Roving:** Soft rubbed or compacted.
- **Cord:** Plain, wax sized or starched.
- **Yarn:** Plain or metallic . . . all grades.
- **Wick:** Commercial and other grades.
- **Rope:** Commercial and other grades.
- **Wovenstone Wire-Woven Wicks:** A tape with inserted brass wire.

Complete data booklet FREE...

Here's a comprehensive study of all asbestos textile products. It's a "must" if you use or contemplate using such products. Send for your copy today.

ASBESTOS TEXTILES

A broad line of high quality asbestos textiles at competitive prices

UNARCO ®

UNARCO PRODUCTS

• UNIBESTOS, Amosite Asbestos Pipe Covering and Block • Calcium Silicate Pipe Covering and Block • 85% Magnesia Pipe Covering and Block • Mineral Fiber Block • Wrap-On Insulation • Lace-On Insulation • Turbine Blankets • Insulating and Finishing Cements • Asbestos Textiles • Packing and Gasketing.

UNION ASBESTOS AND RUBBER COMPANY • FIBROUS PRODUCTS DIVISION

DEPT. 213, Bloomington, Illinois

For more facts circle 222 on Reader Service card, p 101

Marsh Mastergauge

...the gauge that has everything!

LEAK-PROOF ONE-PIECE CONSTRUCTION from socket to tip of bourdon tube...accomplished by the exclusive Marsh "Conoweld" process.

STURDY "MARSHALLOY" CASE formed of boiler-plate thickness steel, copper clad inside and outside by "Marshalloy" process to give it all the durability and the corrosion resistance of solid copper with the dependable strength of steel.

SUPERLATIVE "MASTERGAUGE" MOVEMENT with exclusive "coined" sector gear, self lubricating, frictionless action and other refinements that add years to service life.

TYPES FOR EVERY SERVICE...wide range of bourdon tubes including stainless steels and monel. Full range of pressures, vacuum, compound gauges in endless sizes, case styles. Only Marsh has the "Safecase" for dangerous gauge applications.

"Mastergauge" is standard bearer for the broad line of Marsh Gauges fully covered in Catalog 76-G. All are available with the "Recalibrator" —best way to correct a gauge that has been knocked out of adjustment.

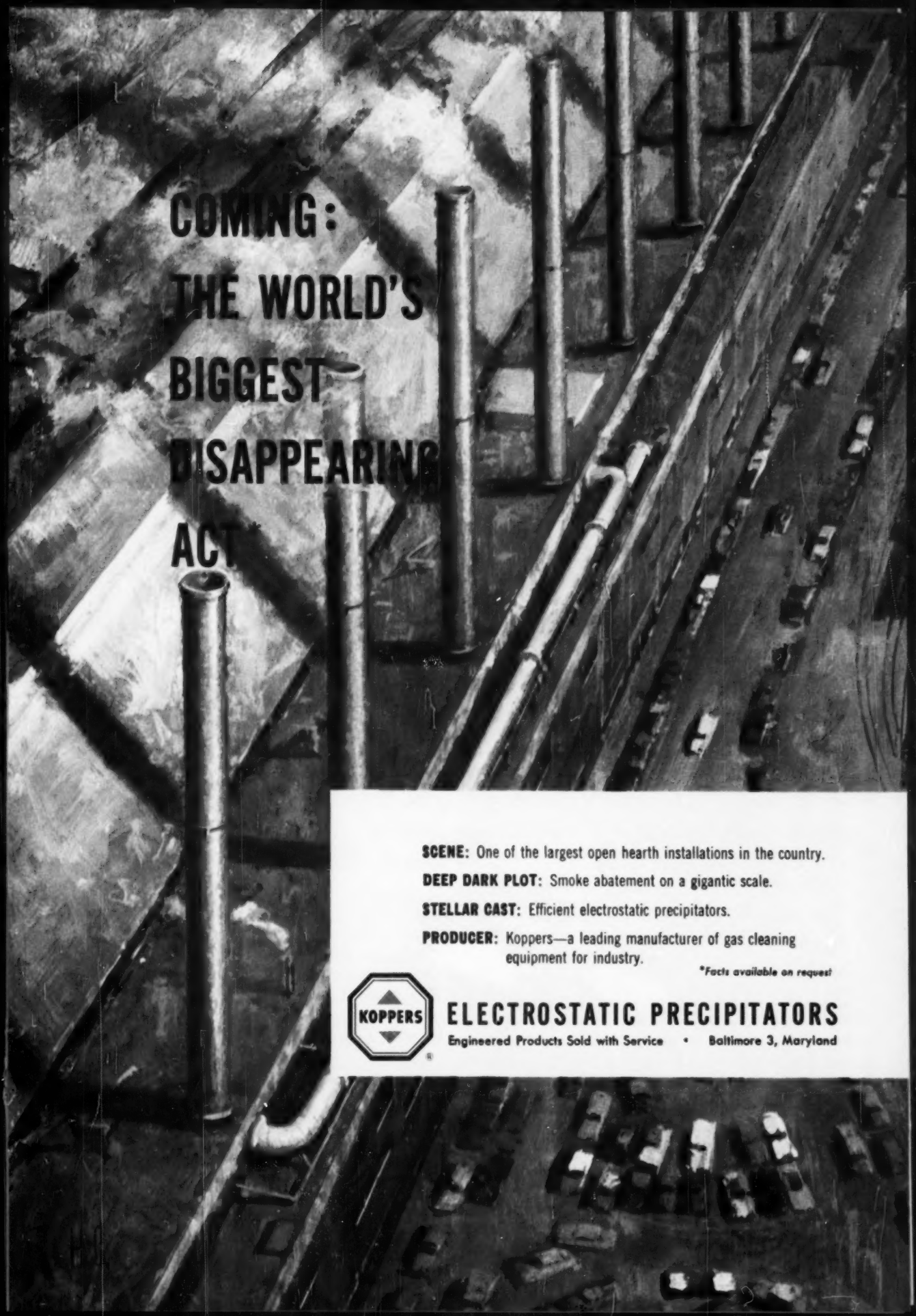
MARSH INSTRUMENT COMPANY
Division of Colorado Oil and Gas Corporation
Dept. F., Skokie, Illinois
Marsh Instrument & Valve Co., (Canada) Ltd.,
8407 103rd St., Edmonton, Alberta, Canada
Houston Branch Plant, 1121 Rothwell St.,
Sect. 15, Houston, Texas

MARSH

"THE STANDARD OF ACCURACY"

GAUGES • DIAL THERMOMETERS • REFRIGERATION INSTRUMENTS • HEATING SPECIALTIES

For more facts circle 223 on Reader Service card, p 101 circle 224 on Reader Service card, p 101 ➤



SCENE: One of the largest open hearth installations in the country.

DEEP DARK PLOT: Smoke abatement on a gigantic scale.

STELLAR CAST: Efficient electrostatic precipitators.

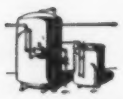
PRODUCER: Koppers—a leading manufacturer of gas cleaning equipment for industry.

**Facts available on request*

KOPPERS

ELECTROSTATIC PRECIPITATORS

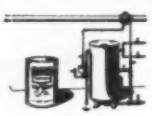
Engineered Products Sold with Service • Baltimore 3, Maryland



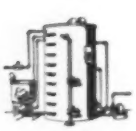
ZEOLITE WATER SOFTENER — manual and automatic. Up to 44% more soft water output from a softener of given size.

ULTRA-DEIONIZERS — produce highest quality mineral-free water. Replace distillation methods at fraction of distillation cost.

DEALKALIZATION & ION EXCHANGE SYSTEMS—Dealkalizers to control alkalinity. Ion Exchangers to produce water of any desired quality.

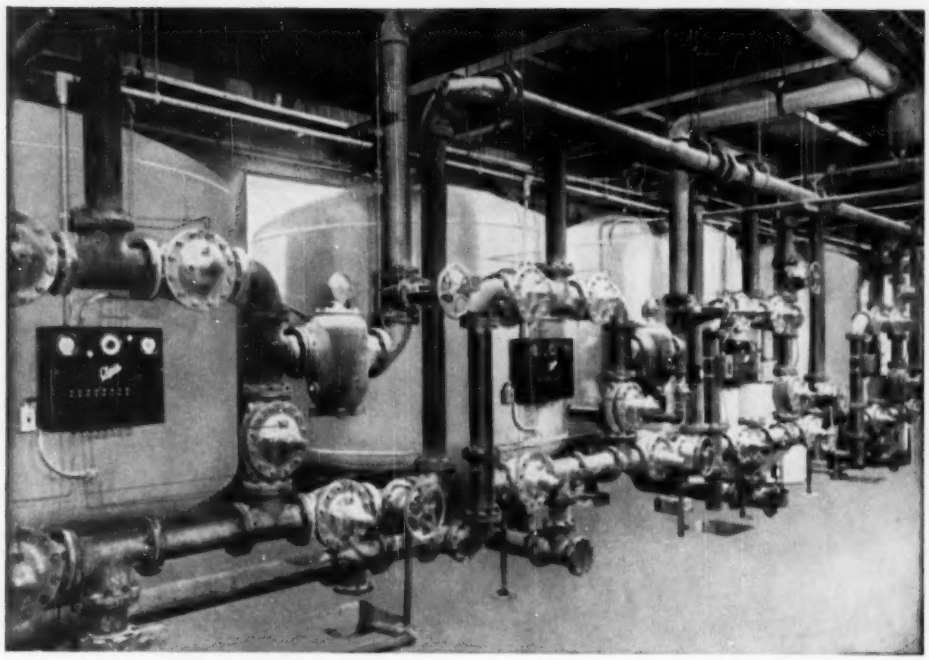


CHEMICAL TREATMENT SYSTEMS—prevent scale, corrosion and depositions with Elgin specially formulated chemicals.



CLARIFIER—for removing excess alkalinity and solids for clarification of turbid waters.

DEGASITORS—for removal of entrained gases from water by aeration.



Typical Elgin Automatic Deionizer

WHO IS QUALIFIED

To handle your water conditioning job?

Today's remarkable advances in water conditioning should suggest methods and equipment that can perform a profitable service for you . . . and this brings up the all-important question:

Who is best qualified to get right down to the practical job of putting these advanced methods to work for you under your specific conditions?

Certainly the best answers will be found in an organization like Elgin that knows and offers *every* modern and authoritative approach to *any* water conditioning problem.

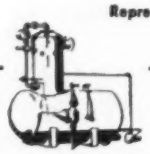
The scope of Elgin equipment and services is briefly touched upon here. To cover the full line would require many pages, but whatever your problem, Elgin with 50 years of intensive specialization is well qualified to solve it. No other organization is better equipped to determine your needs and meet them in the best and most economical way.

Your nearest Elgin Representative would like to put our fifty years of experience to work for you. Or, if you prefer, tell us your conditions and we will send covering bulletins.

ELGIN SOFTENER CORPORATION

130 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities — *In Canada: G. F. Sterne & Sons Ltd., Brantford*



DEAERATING HEATERS—supply make-up water pre-heated by exhaust steam in which CO_2 and oxygen are eliminated.

WATER FILTERS—Diatomite, sand, anthrafilt, activated carbon and oil removal filters in all types and sizes.

For more facts circle 225 on Reader Service card, p 101

rugged and weatherproof

ELLIOTT YR TURBINES

Desert heat, arctic cold, driving rain and swirling dust don't faze rugged, dependable Elliott YR Turbines. Tightly sealed against dust, fumes and moisture . . . built strong and husky . . . these machines make dependable, economical drives for pumps, compressors, fans, line shafts, generators and other equipment.

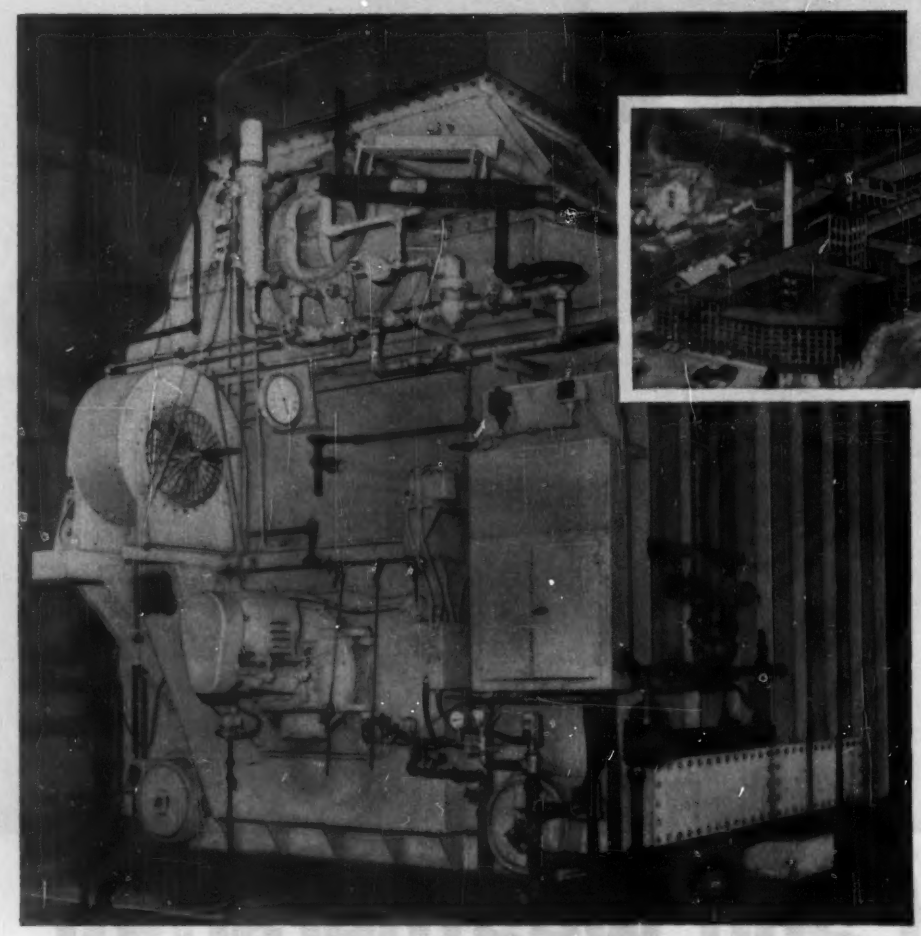
The governor is simple and reliable, and is available in several modifications to match speed and pressure control requirements. YR turbines are designed for easy installation and service. Many key parts are interchangeable for various frame sizes. Four sizes are shown at the right. Write for descriptive bulletin H22-C.

In addition to the units illustrated here, Elliott makes single-stage turbines in special frames, reduction gears, multistage mechanical drive turbines to 50,000 hp, and turbine-generators through 44 mw.

ELLIOTT Company

JEANNETTE, PENNSYLVANIA HD-2

For more facts circle 226 on Reader Service card, p 101



AERIAL VIEW OF TORRINGTON'S EXCELSIOR PLANT, TORRINGTON, CONN. Torrington is world renowned for its manufacture of bearings, needles, bicycles and metal specialties.

ONE OF TWO UNION TYPE MH PACKAGED BOILERS serving Torrington's Excelsior Plant. Equipped for oil firing, this unit has a steam capacity of 15,000 lbs./hr. at 250 psi.

Torrington racks up $12,500 savings in year with first of two Union Packaged Boilers

Selected because its "construction and design appeared better than others . . . physical size fitted into plans," a 20,000 lb./hr. Union Type MH Steam Generator was installed in the Excelsior Plant of The Torrington Company in October, 1955.

Providing steam for process and space heat, the new boiler quickly proved its worth. In October 1956, as a second MH Unit (15,000 lbs./hr.) was placed in operation, Torrington had this to say about the first: "Estimated savings for the first year are $12,500, as compared to our old coal burning hand fired boilers."

Throughout industry, numerous concerns report like economies as the result of modernizing with modern Union Type MH Steam Generators.

Completely shop-assembled at Union Iron Works for delivery via rail or truck, Union Packaged MH Units are patterned after larger but similar field erected Type H Boilers, originated by Union over 17 years ago.

With standard units designed in 13 sizes from 10,000 to 50,000 lbs. of steam per hour, Union Packaged Steam Generators can be readily equipped to handle multitudes of needs formerly requiring costly field erection and special engineering.

GET FULL DETAILS including cut-away illustrations, tube layouts and dimension tables by writing for Bulletin MH-353.

UNION

UNION IRON WORKS

ERIE, PENNSYLVANIA

(Advertisement)

Hall Industrial Water Report

VOLUME 8 JANUARY 1960 NUMBER 1

Don't Carry Things Too Far

This familiar expression predicts trouble. Just as trouble with deposits comes when steam carries droplets of boiler water too far—out of the boiler steam drum into superheaters, turbines, heat exchangers and heating systems. Superheater tubes burn out, turbines lose efficiency and capacity, and heat transfer suffers.

Hall engineers know how to combat carryover problems. They are familiar with the mechanical methods of purifying steam and know how to determine whether antifoams are also needed. They can help you to improve steam quality just as they can serve you on other water problems in the steam plant, or in cooling process or waste water disposal facilities.

Spreading Oil on the Water

At a southern synthetic fiber mill serious fouling of a turbine with water-soluble deposits required washing at intervals of approximately three months. This puzzled Hall engineer T. A. McConomy no end because normally his checks on steam showed it to be of good quality. Furthermore, he could find no place in the mill where the condensate, makeup water or boiler feedwater was being contaminated. The use of antifoams in the boiler water did not improve conditions.

One day heavy carryover occurred —so heavy that steam temperature temporarily dropped almost 100°F. The alert operators collected samples of boiler water. Analysis showed one to contain 28 ppm of ether-extractable material and the other an astounding 1185 ppm. Infrared analysis showed the ether-soluble material to be largely lubricating oil.

What was the source of the oil? Previous investigation had ruled out the mill. McConomy asked the operators to keep a careful watch on the river water at the plant intake. A few days later an oil slick showed up.

It was now easy to trace the source of contamination upstream to several service stations and small manufacturing plants which were dumping oil into the river. The job of getting them to stop was harder. So the filter plant operator now has an extra duty called "river watching." This makes possible the diversion of oil-contaminated water from the steam plant, and saves the cost of additional, expensive equipment.

Baffling Leaks

Carryover was so bad in a midwestern automobile body plant that steam traps were continually plugging and a turbine-driven air compressor couldn't produce at rated capacity. It was determined that one boiler of three was causing all of the trouble.

Each boiler was put through its paces while steam quality was checked conductometrically by Hall engineer L. P. Dougherty. Steam from two of the boilers was found to be excellent under all conditions, even when operated at ratings well above normal. The third boiler acted all right until the rating was pushed a little above normal, then gobs of water went out in the steam.

Having proved which boiler was the bad actor, Dougherty asked that it be taken out of service for inspection of steam drum internals. Sure enough, the baffles were found to be hanging loosely, leaving spaces where steam could short-circuit to the offtakes without following the designed path.

Baffles were tightened and the leaks closed up. Additional steam purity checks showed that the repairs were effective. Trouble stopped and has not recurred.

Embrittlement in Steam Line

Failure of steam lines due to caustic embrittlement is almost unheard of. It can occur, however, if the necessary conditions are present. Caustic soda must get into superheated steam to produce a concentrated solution and this solution must contact highly stressed metal.

In one case high-pressure steam was reduced to 60 psi and desuperheated to within 40°F of saturation temperature. Desuperheating water was a mixture of condensate and deionized water. The pH value of the deionized water was adjusted to 9.0-10.0 with caustic soda for protecting uncoated steel pipe from corrosion and for establishing desired alkalinity in the boiler water.

The steam line was welded. Chill rings had been used and there were open spaces between the rings and the internal surface of the line. When desuperheating water was trapped in the spaces, it concentrated to produce a strong caustic solution in contact with the stressed metal in the welds. Cracking and failure occurred.

In this instance the major source of caustic soda was that added to the deionized water. However, sodium leakage or insufficient rinsing after anion exchanger regeneration could supply the caustic soda. Obviously then, deionizers must be operated with this in mind if the water is to be used for desuperheating.

Water is your industry's most important raw material. Use it wisely.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve your particular water problems, write, wire or call address below.

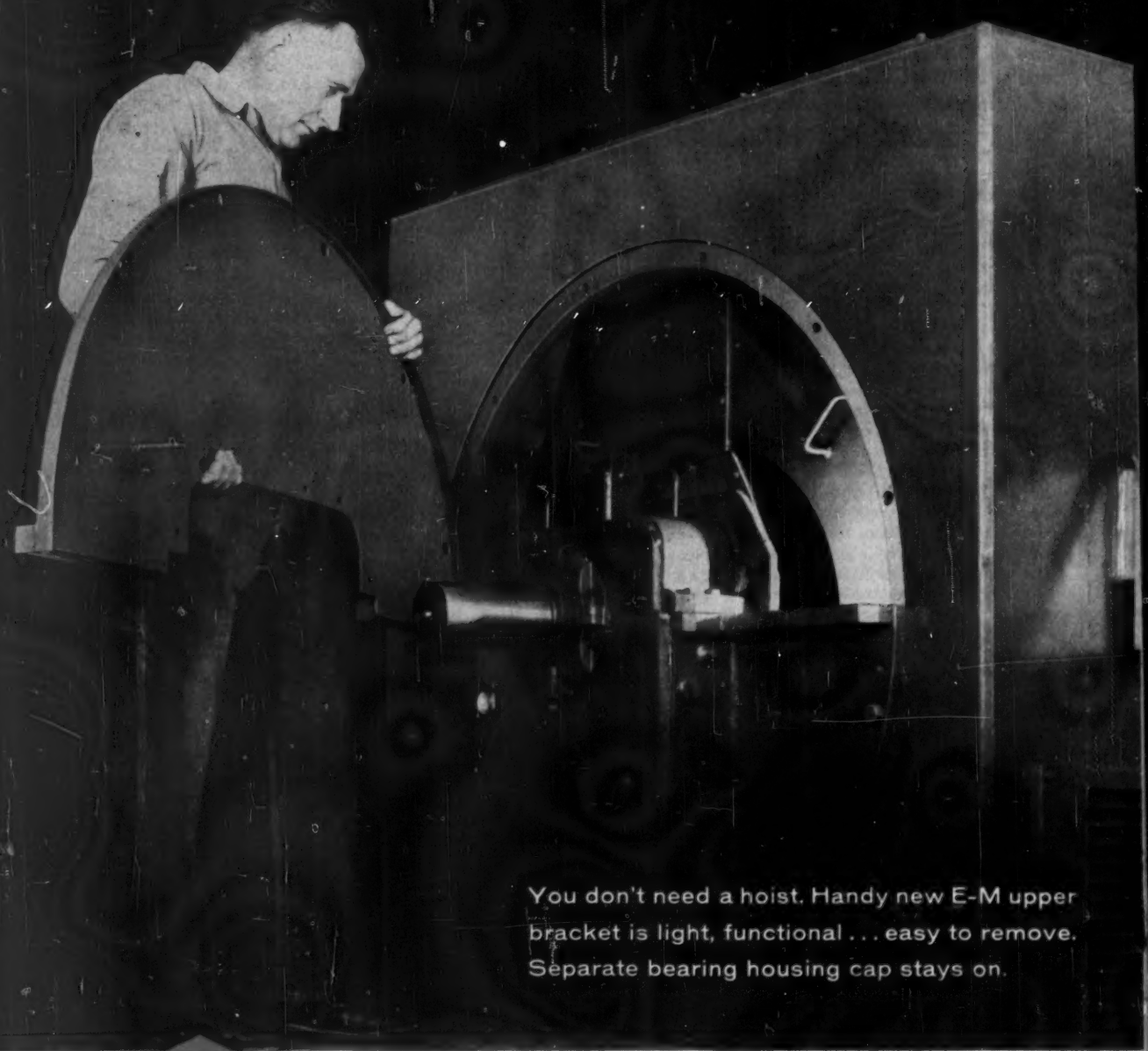
HALL LABORATORIES
DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

 For more facts circle 228 on Reader Service card, p 101

NOW Save costly man-hours, reduce downtime with the new E-M Straight-Up-Ventilated Boiler Feed Pump Motor. It gives you...

Quick and Easy Access



You don't need a hoist. Handy new E-M upper bracket is light, functional . . . easy to remove. Separate bearing housing cap stays on.

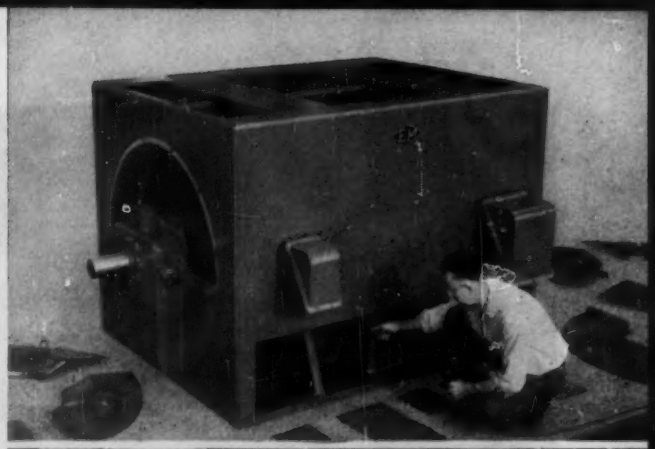
E-M

1200-TPA-21M

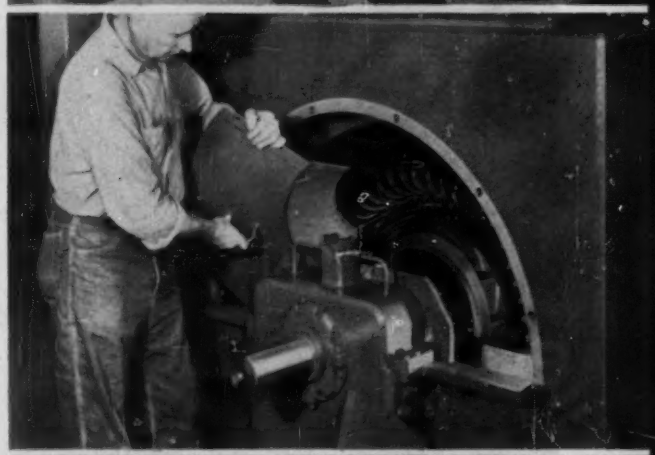
ELECTRIC MACHINERY

Builders of the new pump motor

It's easy to remove louvers —just unbolt, lift off. Access plates let you clean thoroughly behind stator core.

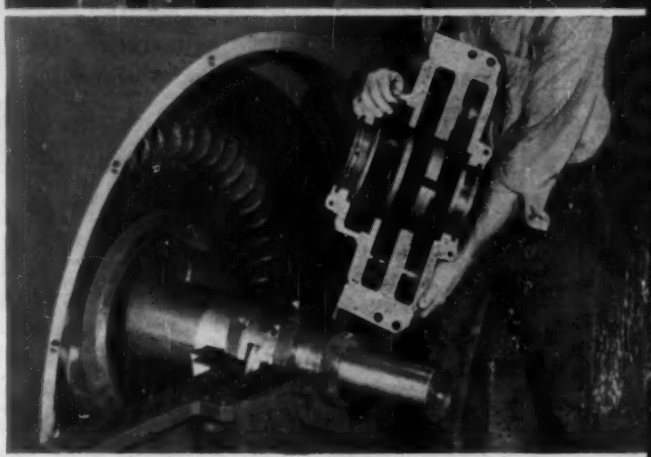


Coils are readily checked for condition and cleanliness. Four-section air baffle comes out easily without taking off lower bearing bracket.

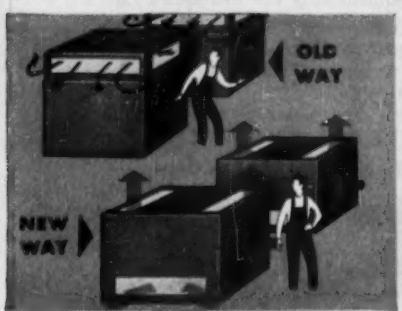


Just lift the cap to inspect bearings. Raise the rotor shaft to roll out the lower bearing half.

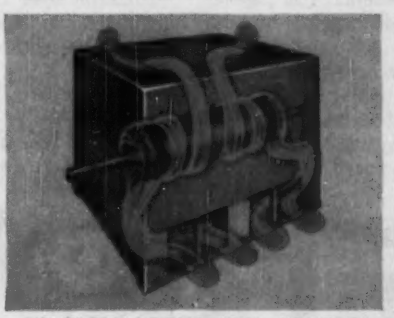
Learn more about the motor that's a pleasure to service. Ask your nearby E-M Sales Engineer and write to the factory for your copy of illustrated brochure No. 1134-P.



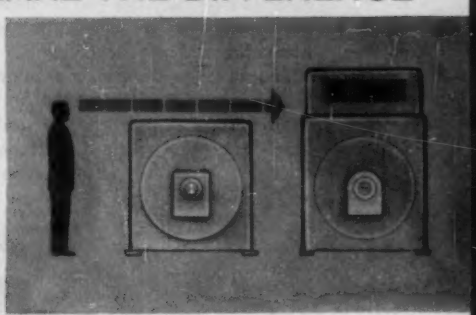
More of the MANY BIG DIFFERENCES that MAKE THE DIFFERENCE



STRAIGHT-UP-VENTILATION



AIR-FLOW ACOUSTICAL CONTROL

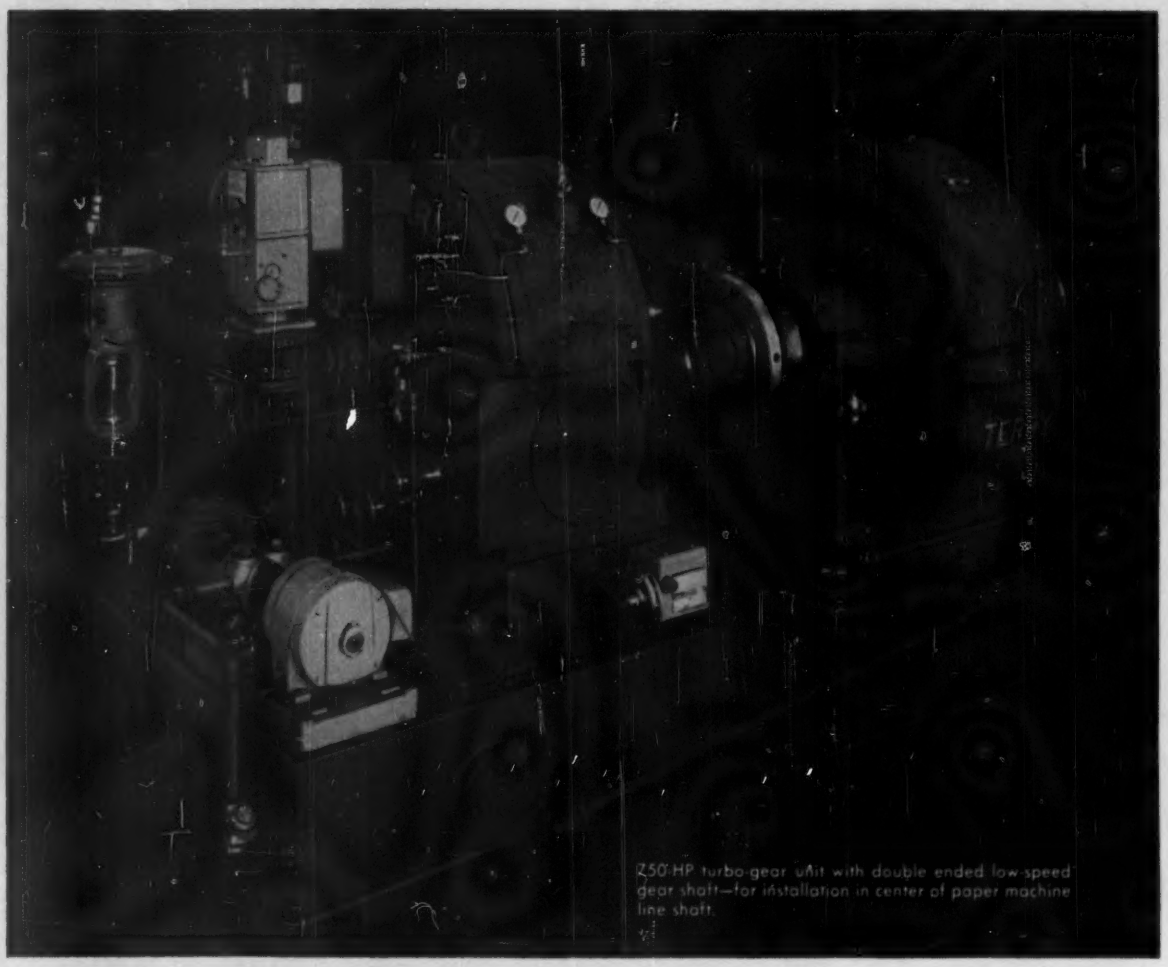


MINIMUM HEIGHT—MAXIMUM VISIBILITY

MFG. COMPANY MINNEAPOLIS 13, MINNESOTA

that performs as well on the job as on the test stand

For more facts circle 229 on Reader Service card, p 101



750 HP turbo-gear unit with double ended low-speed gear shaft—for installation in center of paper machine line shaft.

LOW-SPEED TURBINE DRIVES

tailored to meet your requirements

For more than half a century, Terry has been one of the principal suppliers of turbo-gear units for driving slow-speed fans, generators, paper machines, large pumps and the like. Each unit is designed to meet the job requirements. The paper-machine drive illustrated is a good example of this ***individualized engineering.***

In service at a large southeastern paper mill, the unit delivers 750 HP at 3350/500 RPM, with steam conditions of 450 lbs., 660°F and 50 lbs. back pressure. Equipped with a variable-speed governor, operated by remote control, the speed of the unit may be varied through a 10:1 range. Other features include forced-feed lubrication to turbine and gear bearings, and automatic shutdown and alarm in case of low oil pressure.

Whatever *your* requirements for low-speed turbine drives, a Terry engineer will be pleased to discuss them with you. Bulletin S-140 covers the full line of Terry turbines; Terry gears are described in bulletin S-130.

THE TERRY STEAM TURBINE CO
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

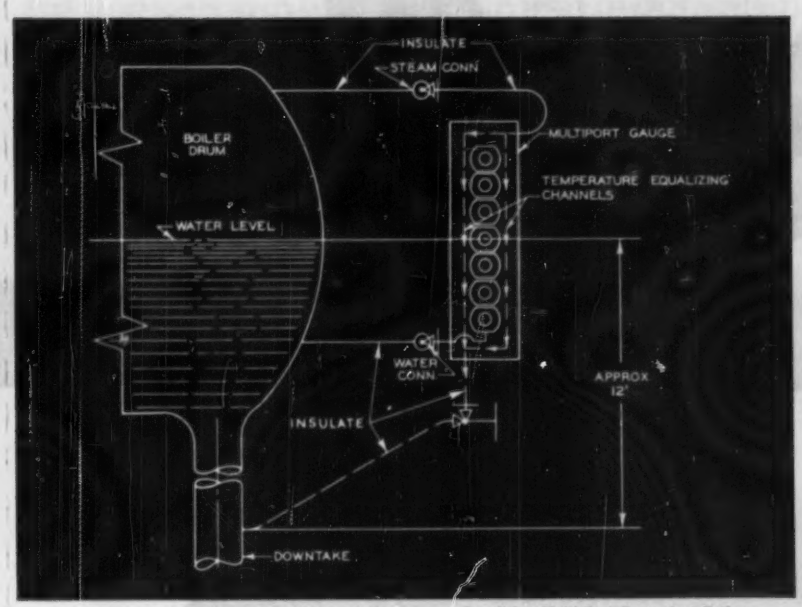
TT-1212

For more facts circle 230 on Reader Service card, p 101

Diamond

Temperature Equalizing MULTI-PORT GAUGE*

Improves Accuracy of Water Level Indication at High Operating Pressures



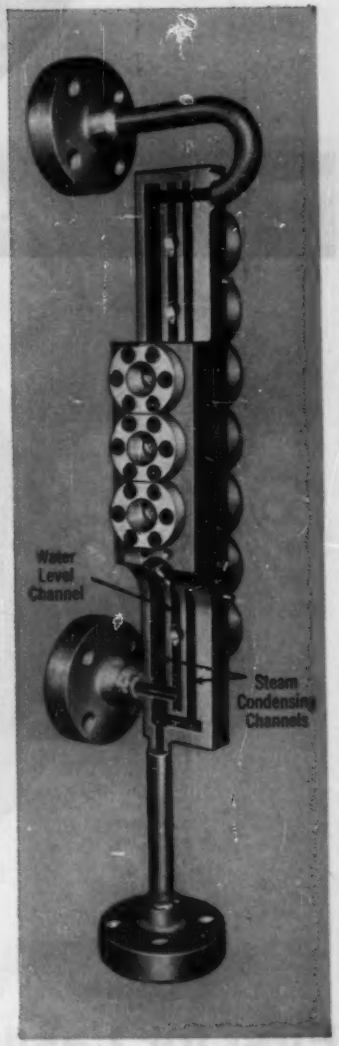
Diagramatic illustration of new Diamond Temperature-Equalizing Multi-Port Gauge installation.

By a simple reliable means the Diamond Temperature Equalizing Multi-Port Gauge* effectively reduces error in gauge level reading at high operating pressures.

Gauge error (resulting from the gauge temperature being lower than boiler saturation temperature) is substantially avoided by introducing supplementary gauge heating in the form of steam condensing channels. These channels are parallel to the gauge water level channel as illustrated, and serve to heat the gauge level channel by direct conduction of heat from condensing steam through the gauge body itself. No external source of energy or control is required. The heating channels have a natural circulation system independent of the gauge level channel so that no faulty operation can occur under any circumstance.

Ask your local Diamond office or write directly to Lancaster, Ohio for Form 2150 for further information.

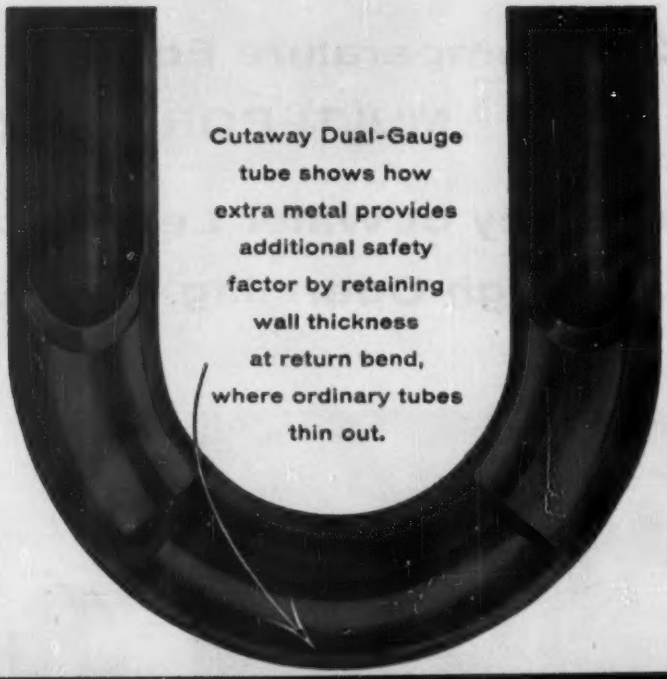
*Patent Applied For.



Cut-away sections illustrate independent gauge body heating channels of the new Diamond Temperature-Equalizing Multi-Port Gauge.

DIAMOND POWER SPECIALTY CORP. 8274
LANCASTER, OHIO
DIAMOND SPECIALTY LIMITED—Windsor, Ontario

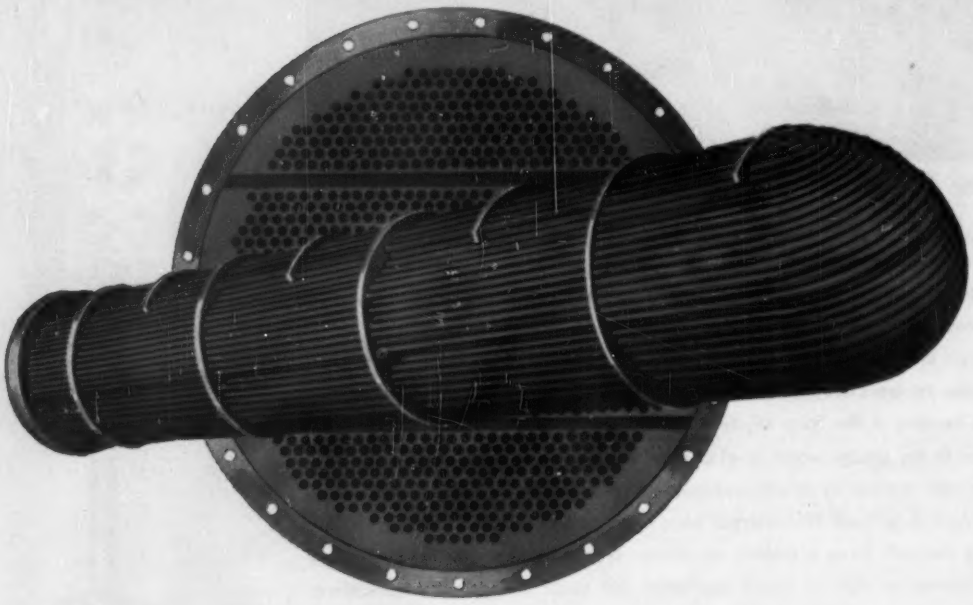
For more facts circle 231 on Reader Service card, p 101



Cutaway Dual-Gauge tube shows how extra metal provides additional safety factor by retaining wall thickness at return bend, where ordinary tubes thin out.

Specify

DUAL-GAUGE



First for Lasting Quality—from Mine to Market!

To keep tubes uniformly strong
in condensers, feed water heaters,
heat exchangers and similar equipment...

PHELPS DODGE

TUBING!

- Provides heavier wall thickness:
  - **a.** At one or more points in tube length to compensate for thinning on outer portions of return bends.
  - **b.** At points of support.
  - **c.** At tube ends to meet special requirements.
- Produced in all standard sizes or manufactured to the particular design requirements of individual customers.
- Available in Cupro-Nickel, Red Brass, Aluminum Brass, Admiralty metal and Muntz metal.

PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Denver, Fort Wayne, Greensboro, N.C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

For more facts circle 232 on Reader Service card, p 101

Background photo shows Cooper-Bessemer FM compressors for soot blowing service in a large western utility.

ECONOMICS OF BOILER CLEANING WITH COMPRESSED AIR (Versus Steam)

1. Pressure is always adequate to do clean, thorough job.
2. Better programming with air gets better cleaning results for higher boiler efficiency.
3. Lower cost for blowing medium less waste.
4. No quenching action on hot alloy tubes or pressure vessels.
5. Much less maintenance of blower equipment due to erosion, corrosion, parking wear.
6. Improved housekeeping: no steam or condensate leakage.
7. Greater over-all economy at blowing medium on evaluated basis.
8. Eliminates condensate makeup required when blowing with steam.

For more facts circle 233 on Reader Service card, p 101

Soot blowing with air is faster, cleaner, less costly

...a report on soot-blowing applications by **L. B. Schueler,** *Power Plant Consulting Engineer, The Cooper-Bessemer Corporation*

The big reason why power companies and their consultants are switching from steam to air for soot blowing is *to reduce costs.* Compressed air does the job more thoroughly, uniformly, with less mess and at less cost. Its high efficiency increases the capacity, availability and economy of the entire furnace and boiler! Total maintenance cost is very much lower.

The whole story is given in the reprint of an article, "Steam or Air: Which costs more for boiler cleaning?" Write for your free copy. We will gladly work with you on your plans for compressor facilities for soot blowing . . . or other power plant needs. Call the nearest office.

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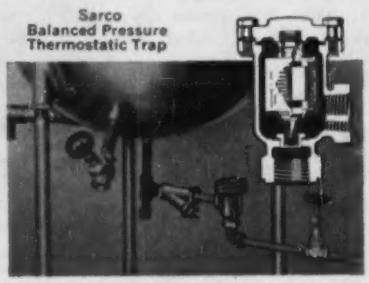
NOW... MATCH STEAM TRAPS

THERE'S no such thing as an all-purpose steam trap. That's why it pays to know what each trap has to offer. Here are five examples that demonstrate how you can match the correct steam trap type to the exact requirements of *each* application.

EXAMPLE 1: Outside Tracer Lines: A tough set of requirements

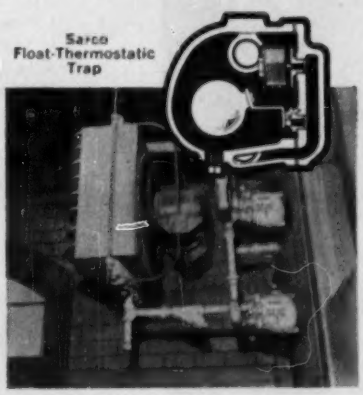
One of the most demanding sets of requirements a steam trap has to face is found in *outside steam tracing*. The trap must not only rid tracer lines of condensate and air immediately they're formed, but it must do so under exacting conditions. Pressures on each trap may vary widely. Installations may be remote and inaccessible to service. Water hammer may be a constant threat; freezing may be a hazard. Only the unique Thermo-Dynamic trap takes all these demands in stride. The Sarco TD-50 operates perfectly *without adjustment* through its full pressure range of 10-600 psi. It's virtually immune to water hammer and won't freeze when installed with a free discharge. Maintenance is, therefore, negligible. Compact, requiring no external support, the TD-50 is just about the easiest trap in the world to install. Once it's installed, you can forget it. You can count on an extremely long, trouble-free service life with minimum maintenance attention.

More closely than any other model, the TD-50 approximates an all-purpose trap. However, special application requirements might dictate the use of another type of Sarco trap. Sarco engineers stand ready to help you solve any trapping problems.



EXAMPLE 2: For steam jacketed process kettles: a trap that operates immediately on start-up and self adjusts to both low and high pressures

When a large steam-jacketed process kettle starts up, the condensate load is high, and all air in the jacket must be released quickly. At this stage, however, the jacket pressure is low; yet it builds up rapidly as the process continues. Because a SARCO No. 9 Balanced Pressure Thermostatic Trap is wide open on start-up, it releases initial air and condensate without the need for a bypass. And because it is self-adjusting, it works just as efficiently during the first processing stage when the jacket pressure is high. There are no seats to change for various working pressures. You can see why it is the obvious choice for steam jacketed process kettles.



EXAMPLE 3: How to prevent water-logging in unit heaters and blast coils

All unit heaters and blast coils have a relatively small internal volume in comparison with their steam condensing capacity. Even slight water-logging can reduce heat output seri-

Impartial advice on trapping because
ONLY SARCO MAKES ALL 5 STEAM TRAP TYPES

TOPICS

SARCO

TO YOUR TRAPPING NEEDS

ously. Pressures may vary widely under automatic temperature control and so may the load because of variable demand. A trap to handle this application must adjust itself instantly to pressure and load charges. The most precise answer to this problem is the SARCO Float and Thermostatic Trap—and here's why: it releases air on start-up and during running, and, because it discharges condensate continuously, it does not set up in the system violent pressure changes that would upset close control.

Sarco Liquid Expansion Trap

EXAMPLE 4: How to release low temperature condensate

When condensate cannot be returned to the boiler feed tank either because of distance or because it may be contaminated, it's economical to utilize some of the sensible heat as well as the latent heat of the steam.

For this purpose a trap must be capable of releasing condensate to temperatures as low as 100° F.

The sound trap selection here is the SARCO No. 871 Liquid Expansion Trap because it can be set to release condensate at temperatures down to 100° F. regardless of supply pressure. This performance assures maximum steam economy. The Sarco No. 871 handles the starting load easily because of its wide open valve, which throttles the flow as the condensate temperature rises. Furthermore waterhammer cannot reach the operating element. No other type is as nearly perfect for this specific problem.

Sarco Bucket Trap

EXAMPLE 5: Economic handling of Water Hammer and Corrosive Conditions

In applications in which water hammer or corrosive conditions are encountered but in which low pressures or extremely high back pressures preclude the use of the Thermo-Dynamic trap, the Sarco Inverted Bucket Trap is recommended. While the Sarco I. B. is not exactly a fuel miser, its relatively rugged construction will withstand considerable water hammer; and, when it is fitted with stainless steel internal parts, it offers excellent resistance to corrosion.

* * *

CONCLUSION: The right application is the economical installation

When you choose steam traps that serve their purpose without frequent adjustment, and without maintenance or replacement problems, you save on down-time, man-hours, spare parts, and production slowdowns.

You can get the money-saving solution to every trap selection problem by consulting Sarco. You get impartial solutions, because only Sarco makes all 5 types of steam traps: Thermo-Dynamic*, Thermostatic, Float Thermostatic, Liquid Expansion, and Bucket.

You also get the benefit of Sarco's 50 years of specialized experience in the manufacture and application of temperature regulators, industrial air vents, pipeline strainers, dial and industrial thermometers, heating and cooling controls, heat exchangers, heating control systems and heating specialties.

For literature or impartial help in solving your steam trapping or control problems, contact your local Sarco Sales Representative, or write direct to Sarco. 1440

*U.S. Pat. No. 2,817,353, T.M. Reg. U.S. Pat. Off.

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For more facts circle 234 on Reader Service card, p 101

Still ANOTHER Cottrell Advancement By Western Precipitation...

UNIQUE "FULL-RANGE" RAPPER CONTROL PROVIDES ENTIRELY NEW STANDARDS OF VERSATILITY

Rapping Frequency...Rapping Intensity...Rapping Pattern

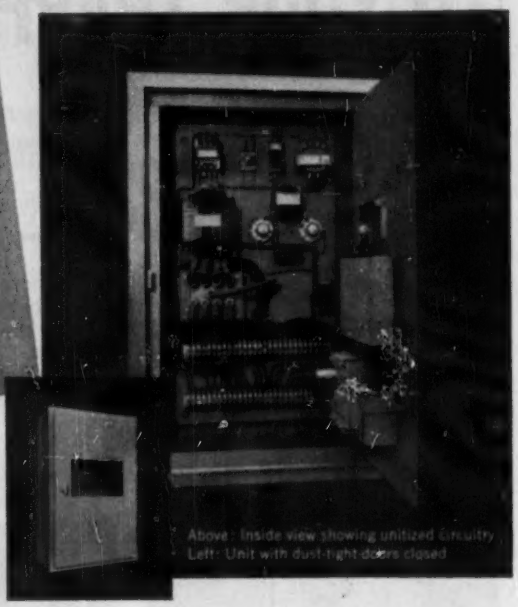
ALL EASILY ADJUSTABLE TO MEET OPERATING REQUIREMENTS

THE PROBLEM:

In the operation of Cottrell Precipitators it is necessary to remove the dust, fume or fly ash that has collected on the plates and cause it to be deposited in a hopper for subsequent removal from the Precipitator. The Rapping System should accomplish this removal with minimum disturbance to the already collected material (to avoid re-entrainment) and with maximum cleaning of the plates.

However, collected materials vary widely in their physical characteristics. Some are sticky. Some agglomerate readily and in thick layers without disrupting electrical operation. Still others have no tendency whatever to agglomerate, but form a sheet of loose particles on the plate.

There is no "typical" dust—no fixed set of conditions to be met. Yet the Rapper System must be readily adaptable to efficient dust removal, regardless of dust characteristics!



Above: Inside view showing unitized circuitry
Left: Unit with dust-tight doors closed

THE SOLUTION:

With so many variables to be compensated, unusually wide adjustability of the Rapper System has long been a prime objective for optimum operating efficiency. But complex factors have prevented its attainment until development of Western Precipitation's new "Full Range" Rapper Control.

By simply adjusting a few dials, "Full Range" Control permits:

- **FULL FREQUENCY ADJUSTMENT** from a complete rapping cycle every 50 seconds to one every 3½ hours...or any desired cycle in between!
- **FULL INTENSITY ADJUSTMENT** from zero to maximum over an unusually wide range!
- **FULL PATTERN ADJUSTMENT** 2, 4 or 8 impacts per cycle can be selected, with each cycle varying from light to heavy on successive impacts within the cycle—all automatically controlled to a choice of pre-selected operating limits!

Other Important Advantages...

Greater Safety: The "Full Range" Control has no dangerous high voltage circuits to endanger personnel. Entire unit is in "low-voltage" category.

All "Passive" Design: There are no motors, gears, or other high maintenance components in the "Full Range" Control. It is completely electronic.

Space-Saving Compactness: The "Full Range" Control requires about *half* the space of previous designs. Also is water and dust tight—can be located virtually anywhere.

Unitized Circuitry: All related parts are unitized into separate "cans" for simplified maintenance.

Free! **NEW BROCHURE** which describes and illustrates the new "Full Range" Rapper Control—the latest product of Western Precipitation's program of continuous advancement!

For quick assistance, call or wire **collect** *our nearest office.*

A-W-101

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CMP Combination Units
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Here are the unique advantages of Pfizer Citric Acid that you can discuss with your chemical cleaning service company:

1. Citric acid is highly efficient in removing imbedded metal and oxide film from stainless steel.

2. Citric acid's excellent sequestering ability prevents reprecipitation of dissolved scale.

3. Citric acid cleaning completely eliminates the possibility of chloride stress corrosion.

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5. Citric acid is sold as a dry, 100% acid—meaning savings in storage and handling.

6. Citric acid is water soluble, easy to handle, and non-toxic.

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(Advertisement)

Some Straight Talk On Steam Trap Capacity

...or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counterclaims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

Area of orifice is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

Density of condensate depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

Pressure differential across the trap is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.

2. Distance the trap valve is moved from the valve seat.

3. Back pressure on the trap with orifice closed; i.e., return header pressure.

4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:

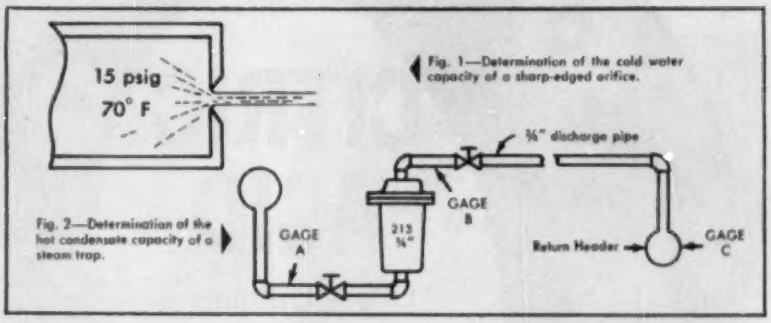

Fig. 1—Determination of the cold water capacity of a sharp-edged orifice.

Fig. 2—Determination of the hot condensate capacity of a steam trap.

Density of condensate. As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

Pressure differential across the trap. With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hook-ups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

• • •

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

Armstrong Machine Works
8121 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

"See our catalog in Sweet's Plant Engineering File"

For more facts circle 237 on Reader Service card, p 101

circle 238 on Reader Service card, p 101 ➤

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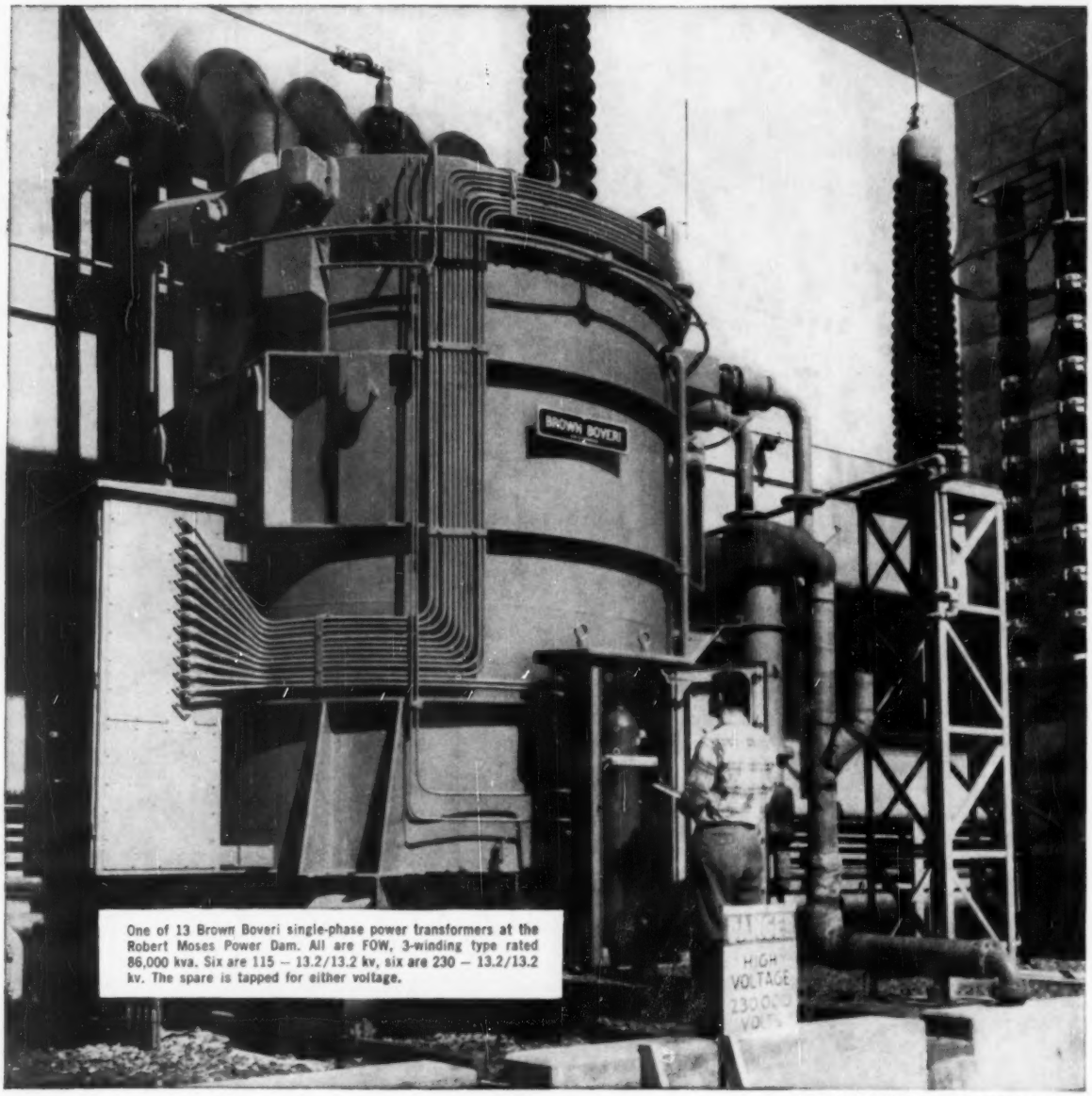


One of 13 Brown Boveri single-phase power transformers at the Robert Moses Power Dam. All are FOW, 3-winding type rated 86,000 kva. Six are 115 – 13.2/13.2 kv, six are 230 – 13.2/13.2 kv. The spare is tapped for either voltage.

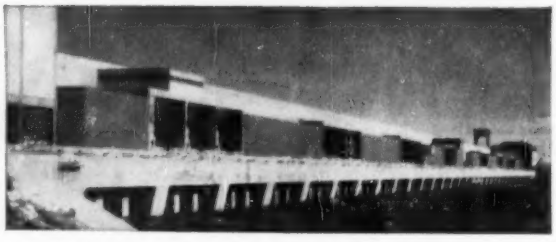
PHOTOS COURTESY OF N. Y. STATE POWER AUTHORITY

ALL'S QUIET AT MASSENA

You've heard the experts say it: Low noise means good design, tight construction. We agree. It's worth a trip to Massena just to hear the quiet around these Brown Boveri transformers.

Other features that can't be heard: the compact size, the light weight per kva, the high efficiency, the reliable service facilities . . . and the substantial dollar savings for a cost-conscious power producer.

Many of these features are due to Brown Boveri's exclusive radially laminated core. We'll be glad to give you full information about this core design and other features of Brown Boveri power transformers.



The Moses-Saunders Power Dam near Massena, N. Y., second largest hydro plant in the U. S. It was constructed jointly by the Power Authority of the State of New York and The Hydro-Electric Power Commission of Ontario.

BROWN BOVERI Brown Boveri Corp., Dept. P-1, 19 Rector Street, New York 6, N.Y. Agents in 27 U.S. cities.

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LOUIS N ROWLEY, EDITOR • JANUARY 1960 • ESTABLISHED 1882 **Power**

The '60's—what do they hold?

AS another January rolls around, many of us will indulge in the familiar New Year sport of trying to divine what the upcoming 365 days may bring. In this January of 1960, marking the beginning of a new decade, the more venturesome among us may be tempted to essay a 10-year look into the future. And a good future it promises to be, particularly for those of us who live and work in the realms of science and technology.

The experts may, and do, differ on the growth of our economy during the next ten years, but few will quarrel with the thesis that technical progress will continue at an accelerated pace. Major reason for the general confidence in this area is continued growth in business expenditures for research and development—estimated to run in excess of $9 billion for the year just past.

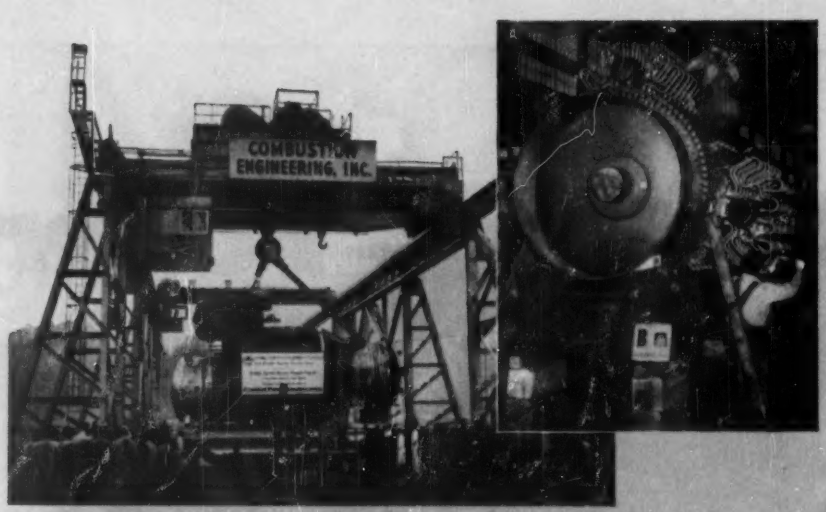
Even without that statistic, technical men would still see the promise of an exciting future in a host of developments that may well make long strides toward maturity in the 1960's. Certainly some of the more spectacular advances will be registered in the glamorous field of space technology, yet a recent trip to Cape Canaveral reminds me again of the tremendous catalyzing effects of missile development on other fields—instrumentation and control, for example.

And right there, of course, is a segment of our own field that is moving fast today and will move even faster in the 1960's. Completely automated power stations now in the design stage will go operational and yield the experience we need to apply highly sophisticated control systems more widely and more intelligently.

In the still-new area of nuclear activity we have already acquired experience with plants of commercial size and should soon accumulate considerably more. To the pessimistic, this early experience has been disappointing, particularly with respect to cost. In a more balanced view, this means that the path to competitive nuclear power is merely longer than we had thought. We can be confident that the 1960's will see the journey well advanced, perhaps completed.

More developments that promise excitement for the next decade lie in the current swelling interest in various schemes for direct conversion. Thermoelectric systems (see pp 57-60), thermionic devices, fuel cells, and the magnetohydrodynamic principle are all receiving intensive study. As we advance into the '60's we will gain an ever-clearer view of the roles direct conversion may play in the expanding energy world of tomorrow.

If to these radically new approaches we add the constant struggle to develop and improve long-familiar types of energy-system equipment—steam generators, turbines, pumps, motors and a host of others too great to name—you can see why I take no risk when I predict that the 1960's will be full of challenge for engineers. And because we face that challenge from an ever-expanding base of knowledge and experience, you can see why I am equally confident that the pace of technical progress will continue to accelerate.

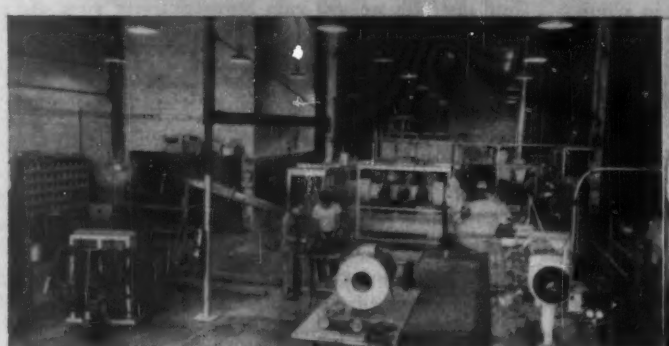


(Left) The huge riverside crane at Combustion's Chattanooga Division easily lifts this 92-ton stainless steel reactor vessel — the most complex reactor vessel built to date — into a barge for shipment to the Enrico Fermi Power Station, Lagoona Beach, Michigan.
(Right) Stainless steel sodium heat exchanger consisting of a series of tubes within tubes, encased in a pressure vessel.

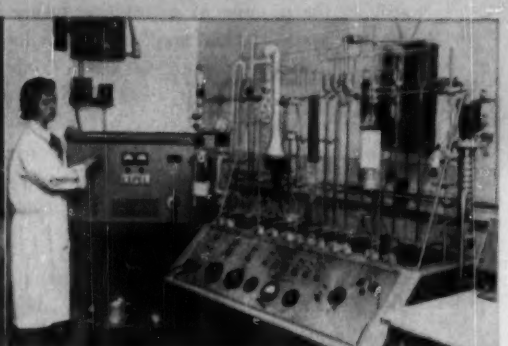
What C-E is doing to advance

The strange and wondrous world of the atom has been examined and surveyed by C-E scientists and engineers since 1946. The object—to put the controlled energy of the atom to productive use for the generation of power. The result—a wealth of knowledge and experience in the application, design and manufacture of nuclear power equipment. Backed by specially designed laboratories and manufacturing facilities, this knowledge and experience—greatly augmented and enriched by the acquisition of the General Nuclear Engineering Corporation early last year—has enabled C-E to undertake many kinds of nuclear work.

Notable C-E and General Nuclear projects are outlined on the opposite page. Virtually all of them are *current*, and many have a significant relationship to the vital task of making nuclear power competitive with conventional power. Collectively, these projects will contribute importantly to the Company's objective of achieving the same position of leadership in the atomic world of tomorrow which it has long since achieved in present-day methods of power generation.



Partial view of laboratory of General Nuclear Engineering Corporation at Dunedin, Florida, showing equipment used for the study of a high-pressure, high-temperature gas coolant system.



Portion of a laboratory at C-E's Nuclear Division, Windsor, Connecticut, showing gas analysis equipment used for detecting the presence of small quantities of gases in reactor materials.

The 520-foot-long Heavy Vessel Bay at C-E's Chattanooga Division was created especially for the manufacture of heavy nuclear components.

Portion of the 530-acre site occupied by C-E's Nuclear Division at Windsor, Connecticut. This Division is equipped for the development, design and test of reactor systems and the manufacture of reactor cores and core components.

Nuclear Power Progress

C-E NUCLEAR PROJECTS

For Electric Power Stations

- In association with Stone & Webster Engineering Corporation, a design study for AEC of an advanced type of large (236,000 kw) pressurized water reactor power plant.
- A long-term development program for AEC to determine the best means of using nuclear energy to generate superheated steam. (Success in this endeavor will be a big step forward in reducing the cost of nuclear-generated power.)
- Design studies for the Puerto Rico Water Resources Authority, under AEC contract, to determine the best means of adding nuclear superheat to a boiling water reactor.
- Design, research and development work covering a gas-cooled, heavy-water-moderated, pressure-tube type reactor for the East Central Nuclear Group, Inc., and the Florida West Coast Nuclear Group. This development will also lead to a nuclear power plant using superheated steam.
- The development and test of various kinds of fuel elements and fabricating procedures, under contract with the AEC.
- The design and manufacture of reactor vessels, including the largest and most complex vessels of their type built to date, for the Shippingport Station (America's first full-scale atomic power plant), the Enrico Fermi Atomic Power Plant, the Humboldt Bay Nuclear Power Station, and Italy's first nuclear power plant.

For Military Power Plants

- Design study for U. S. Army, under AEC contract, of a truly package type of nuclear reactor, using the boiling water concept, for remote installations. This program includes operation of a prototype boiling water reactor at the National Reactor Testing Station in Arco, Idaho, and the training of military technicians in the operation of the installation.
- The conceptual design and operation of a nuclear test reactor, under AEC contract, to permit full-scale testing of prototype reactor cores for military field plants.

For Naval Power Plants

- The design and manufacture of a submarine reactor system designed to set new standards of accessibility, speed of startup and operational flexibility—and the operation of a land-based prototype installation.
- The design and manufacture of numerous reactor cores, reactor vessels, steam generators and pressurizers for various types of submarines and naval surface ships.

For Merchant Ship Propulsion

- The design and engineering study of a prototype pressurized water reactor for a 45,000-ton tanker, under contract with the AEC and the U. S. Maritime Commission.

Special Studies and Services

- Irradiation studies, fabrication studies, evaluation studies of the general properties of materials, quality control, isotopic analyses, strain gauge and photoelastic testing, basic and applied research in ferrous metallurgy.
- Bio-assays, decontamination, environmental monitoring, radiochemical analyses and radiological safety programs.

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For more facts circle 240 on Reader Service card, p 101

6 Ton Hot Reheat Header

Model test set-up of hot reheat line as reproduced above is approximately 1/10th actual size of the model. Circled area shows position of chrome-moly header in the line.
Size of this hot reheat header can be seen by comparison with men in the picture. It is 21" O.D., fabricated of 2¼% chrome, 1% molybdenum steel.

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The model shown above exactly duplicates—from an engineering standpoint—a hot reheat line which is part of a high-pressure, high-temperature piping system fabricated by Pittsburgh Piping.

The inset shows the position and relative size of the header in the line, and the main illustration is an actual photograph of this header as fabricated in our shops. The complete system, which includes chrome-moly and stainless steel piping fabrication, is one of scores of installations which we have model-tested, fabricated, and erected.

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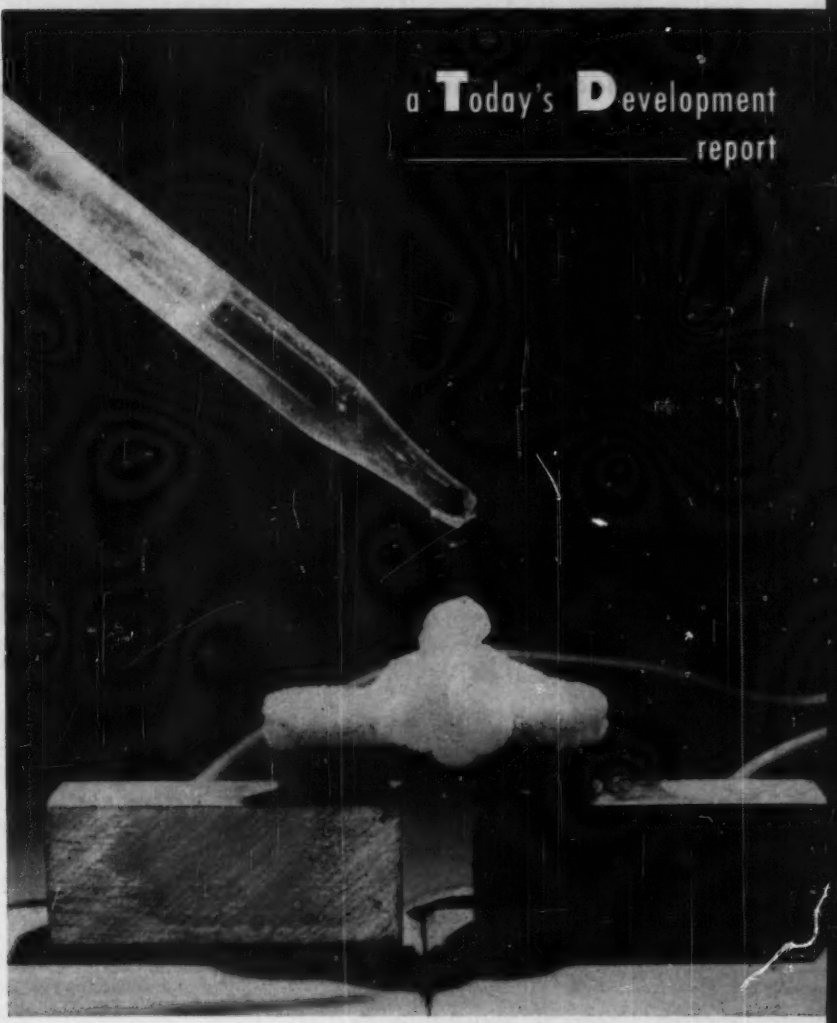
For more facts circle 241 on Reader Service card, p 101

Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge

a Today's Development report



Water dripping on the semiconductor junction, above, froze with dc flowing, heated when the current flow was reversed. Although principle is old, recent developments and space-age needs are fanning . . .

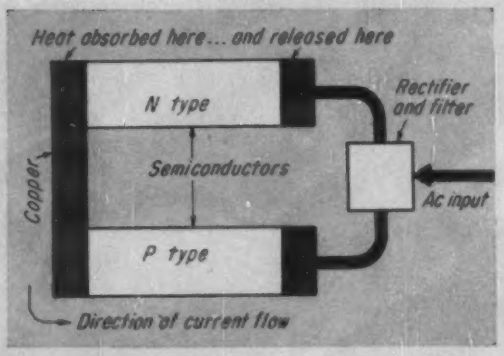
New interest in thermoelectrics

By J J O'CONNOR
Managing Editor

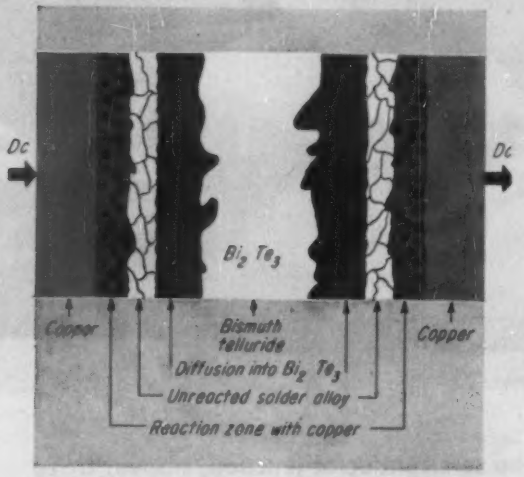
Thumb through your old physics book and you will find the principle behind thermoelectric heating and cooling was rather well spelled out by the French physicist Peltier back in 1834. But little was done of a practical nature until recently. Now, more than 125 years later, we see researchers investigating new materials and applications for the Peltier principle. Why? One reason is the new semiconductors available. Another is simply that present-day needs, particularly in the military, place high potential value on a static device that will yield heat or cold without any moving parts merely by reversing the direction of current flow. Efficiencies are low and problems are many but the future looks promising: The same holds for direct generation of electric power from heat applied to the thermoelements.

continued

Thermoelectric generators are likely feed for small, remote loads



PELTIER EFFECT hinges on passage of dc through junction of two dissimilar metals: heating and cooling results



MECHANICS OF BONDING the materials in typical thermoelement are shown in this cross section of a Bi_2Te_3 unit

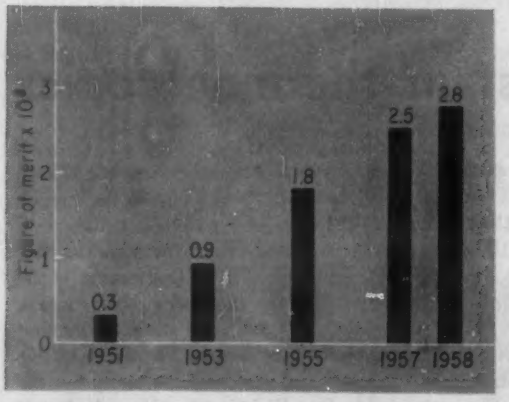


FIGURE OF MERIT improvement as reported by RCA. This value depends on semiconductor materials, affects the COP

Before outlining the most recent advances in materials and applications involving Peltier heating and cooling, let us review the broad picture of the thermoelectric process. The phenomenon of thermoelectricity dates back to what is known as the *Seebeck effect*, discovered in Germany in 1821. Seebeck found that an electric current flows continuously in a closed circuit composed of two dissimilar metals, if the metallic junctions are maintained at different temperatures. This is the principle of the thermocouple. Some years later, in 1834, the French physicist Peltier gave a partial explanation of the phenomenon and observed the opposite effect: heat energy is absorbed at one junction and liberated at the other when a direct current flows in the circuit.

Principle involved can best be explained by considering a typical solid block containing free electrons. These electrons can be made to move under the influence of an electric field or thermal difference. If heat is applied to one side of the solid the electrons will rearrange, becoming more sparse in the warmer region and more dense in the colder. Result is an electrical gradient. We take advantage of this action to a more pronounced degree in a thermocouple, which is a thermoelectric generator. But thermoelectricity is a reversible phenomenon: if heat may be used to pump electrons, then electrons may be used to pump heat. This is the *Peltier effect*.

In Peltier cooling, each electron carries with it a certain fraction of the heat contained in the entire material. So as it moves from the warmer to the colder area, it carries a quantity of heat as well as its unit of charge. Electrons carrying heat from one area to another give a cooling effect as they move across the junction between different materials. Heat they carry is ultimately delivered to opposite ends of the material. For a more sophisticated explanation of semiconductor action involved in Peltier cooling and heating, see POWER, Dec 1959, p 74-75.

Thermoelectric power generation has long been a scientific challenge. If realized on a large scale it could bring widespread changes in our present method of production. It would mean the direct generation of electricity from a coal fire, nuclear reactor or other heat source, skipping the present intermediate apparatus. Inversely, it could make possible refrigeration and air conditioning directly from electric current.

Many companies are hard at work on both aspects of thermoelectrics. Typical: Westinghouse, RCA, Whirlpool, GE. Only recently Westinghouse announced they have built thermoelectric generators which approach the efficiencies of the best automotive engines. They've also built a lightweight radio receiver for use in remote areas which can run ten days on a pint of kerosene. The Russians are credited with having a similar device.

In the Seebeck area, Westinghouse points out that a tiny birthday candle heating a bar on their new thermoelectric compounds generates something over two amp. This shows the possibility of using a similar device as an auxiliary electrical source to power radio, radar and controls in jet aircraft by converting the available heat

What are the Russians doing with Peltier cooling?

A firsthand report from Elisha Gray, Chairman of the Board at Whirlpool Corp, credits the Russians with some half-dozen thermoelectric devices at or near the hardware stage. In a tour through the Institute of Semiconductor Research in Leningrad, Gray saw applications ranging from devices for hospital operating rooms to household refrigerators—latter were far from being in or near the manufacturing stage.

They showed a *microtome* fitted with thermoelectrically cooled plates. It is used for pathological research on human tissue during an operation. The tissue is frozen on the spot and sliced for study. This device had a bismuth-tellurium-selenium set of elements. Power input ran only two or three watts with a *Z* factor of but one.

A number of small cooling chambers were shown using water cooling on the hot side of the Peltier elements. They were able to reach –45 C in these chambers. Air-cooled and measuring about 6-in. dia by 14-in. long, the units looked like factory products rather than experimental shop items. A battery-powered refrigerator, which is in a limited state of production, was finding use in storing medicine.

One device in production is a thermoelectric condensing unit for the trap on a vacuum pump. Of the two sizes available, the smaller is a 30-w device used on a pump handling 40 liters a minute fitted with 12 to 14 elements. The larger model (about 6-in. dia by 12-in. long) consumed 90 w and was matched to a 500-liter vacuum pump.

In the broad field of Peltier cooling, they claim to have accomplished on rare occasions an 85-C temperature differential. This was at operating temperatures in the commercial-refrigeration range. However, they were getting a 60- to 70-C temperature differential with regularity with a *Z* factor of two.

Gray's concluding observation: The Russians' performance with thermoelectric materials is about identical with ours. They get a rare top shot. They, as we, have a problem in finding a low-cost rectifier.

from jet engines directly into electricity. It may mean ordinary heat from a campfire will provide electricity for lights and campsite equipment. Portable electric generators utilizing the thermoelectric principle would be simple to set up and operate at the scene of a fire, flood or other disaster. Remote regions might have measuring devices and automatic radios powered by thermoelectric generators burning fuel from pipelines. As pointed out by Westinghouseman John Kelly, thermoelectric power generation, once a questionable risk, is now desirable choice for a host of applications.

Efficiency can't be overlooked in any serious discussion of thermoelectrics. Ioffe, dean of Russian thermoelectricians, observed that the thermal efficiency of Seebeck's original materials was in the order of 3%. Keep in mind this was the most efficient electric-power source at the time and for some 50 years, actually until the advent of the steam-driven electric generator. The thermoelectric generator is inherently a low-voltage high-current dc source. Kelly of Westinghouse has stated that, in general, Peltier refrigeration efficiency is only about half what you might get from existing devices in the heavier ratings. On the other hand, for small refrigeration devices no compressors exist today that are at all as reasonable in size or efficiency.

U.S. Navy has awarded Westinghouse a contract for an experimental 3-purpose device combining into a single system a thermoelectric air conditioner, space heater and refrigerator freezer. Navy will use the experimental system to test suitability of shipboard thermoelectricity. The three thermoelectric components of the system will be built up of identical elements or modules which can be individually removed and replaced, and can act as building blocks for a larger thermoelectric system. Air-conditioning portion of this system will have full one-ton capacity.

This 3-way unit for Navy use will have (1) a central thermoelectric air-conditioning unit for supplying chilled water to a standard Navy space cooler. Heat removed in chilling the circulating water can be used for space heating or dumped in the sea as waste heat (2) a central thermoelectric heater for supplying hot water to a standard Navy unit space heater (3) a 2-cu-ft refrigerator-freezer capable of maintaining zero F continuously. The three thermoelectric components will be able to operate independently of one another.

Peltier cooling was the theme of a recent all-day meeting in Washington's Hotel Shoreham. Here a hand-picked group of scientists and engineers, mainly from the military and governmental agencies, gathered as guests of some of the researchers in the field—RCA, Whirlpool, Minnesota Mining and Merck. There was an optimistic tone throughout as recent advances in materials and manufacturing mechanics were outlined.

Devices shown at this meeting by Whirlpool were not for sale; they were simply prototypes showing what can be done and suggesting to the military areas where they might be used. For example, a compact water purification unit discussed used thermoelements for simultaneous evaporation and condensing. Details of this unit were brought out by W R Crawford of Whirlpool. Thermoelectric still utilizes a central evaporator surrounded by a blanket of thermoelectric elements in module form with the outer portion of the still serving as the condenser.

continued

Heat-cold-light: all from the same solid-state ceiling panel

Heat is pumped from the steam, condensed by the thermoelements which pull heat from it back into the evaporator. Added to this is the heat resulting from the Joulean heat losses (effective resistance heating of the elements) which helps create steam from the raw water. Plotting watts per pound against current input they reached a minimum value of 177 watts per pound of condensate generated.

Whirlpool has a newer design, called a *sandwich* still. A graphite evaporator serves as the sandwich filler which is surrounded by thermoelement banks. Latter are placed between the inner evaporator and the outer condenser. Remember this is a miniature design simply demonstrating feasibility of thermoelectric distillation of sea water. Where does thermoelectrics stand costwise alongside other methods of distillation? It is impractical to compare finished full-scale units based on extrapolated costs of this lab model, but estimated cost for an operating thermoelectric distillery is $4.48 per thousand gallons. Since a thermoelectric unit would not require cooling water, it could be used to reclaim liquids where water is scarce—in world's arid regions or in space vehicles, for example.

Other prototype devices displayed by Whirlpool included a multiple food compartment for holding precooked meals in the frozen state until a few minutes before needed: flick a switch to reverse current flow through the thermoelements and freezing compartment is converted into an electric oven. Another unit was based on utilization of waste heat to generate electric current which in turn operated a Sprengel type mercury pump suitable for gases and liquids.

Design data on some devices indicates promise. Since 1950 the efficiency of thermoelectric materials has been improved sevenfold. But they still do not compare on a straight efficiency basis with present-day available equipment. Take the Whirlpool thermoelement refrigerator as an example: In a 90-F ambient and at 25 amps the cabinet air temperature is 36 F. Overall *coefficient of performance*, COP, (thermodynamic efficiency) at 25-amp input is about 0.18.

Another Whirlpool device was a cooling-heating panel composed of a multitude of thermoelements. Here, with 15-amp input, cooling capacity was 600 Btu per hr and coefficient of performance about 0.24. Ambient for this test was 95 F and attained room temperature 80 F. Incidentally, these temperatures coincide with ASRE ratings for air conditioners. By comparison, a standard room air conditioner has a COP of about 2.0.

Westinghouse has taken the hot-cold panel idea a step farther by incorporating electroluminescent lighting. Their hot-cold-light panel, composed entirely of solid-state materials, measures a foot square and can develop as much light as a 25-w lamp. It can maintain a surface temperature approaching that inside a household refrigerator. By flicking a switch—reversing current flow to the thermoelements—surface temperature is raised to about 130 F, a value suitable for radiant heating. Westinghouse believes this development may alter today's schemes for heating, air conditioning and lighting homes and commercial buildings.

One of the factors researchers strive to improve is the *figure of merit, Z*. Greater the value of Z, higher is the COP. Numerical value of Z depends solely on properties of the semiconductors used in thermoelements. Maximum figure of merit reported by Dr F W Rosi of RCA is 2.8×10^{-3} for both N and P type Bi_2Te_3. RCA labs are currently working on materials having an average Z of 1.50, over a temperature range between 25 and 525 C: this latter spanability is important.

What's ahead? Some forecasters believe we will have semiconductors with a Z value of about 5×10^{-3} by 1964. And cost of materials should be in for a revision. At present a ¼-in. thermoelement costs between $2.00 and $2.50. With chemical cost of each unit running about 7¢, it is conceivable the future unit cost will drop to 20¢.

Research expenditures are continuing to climb in the whole field of thermoelectrics. Typical: Whirlpool reports spending over $300,000 per year in 1957 and 1958. The figure was estimated at about $400,000 for 1959.

Ferroelectric converter, although not a thermoelectric device, is most recent direct heat-to-electricity converter to get in the news. Developed by IT&T, it is a unique method for producing h-v ac or dc power. It works simply because the dielectric constant of certain ferroelectric materials varies with temperature.

Main element in this device is a large capacitor with a ceramic ferroelectric material, such as barium titanite, serving as the dielectric. This capacitor is maintained in a charged state by a battery through a holding diode. Extremely high voltages can be had by cascading several stages of converter capacitors so output voltage of a preceding stage charges following unit.

Since the new ferroelectric energy converter requires temperature cycling of the capacitors, it is suited for generating ac if a variable heat source is available. IT&T plans to introduce this unit as a power supply for a space vehicle or satellite. Variable temperature can then be had by the relative turning of the space ship. Two large converter capacitors are arranged on opposite sides of the satellite so that one is heated by incoming solar radiation while other is cooled by being out of the sun's path.

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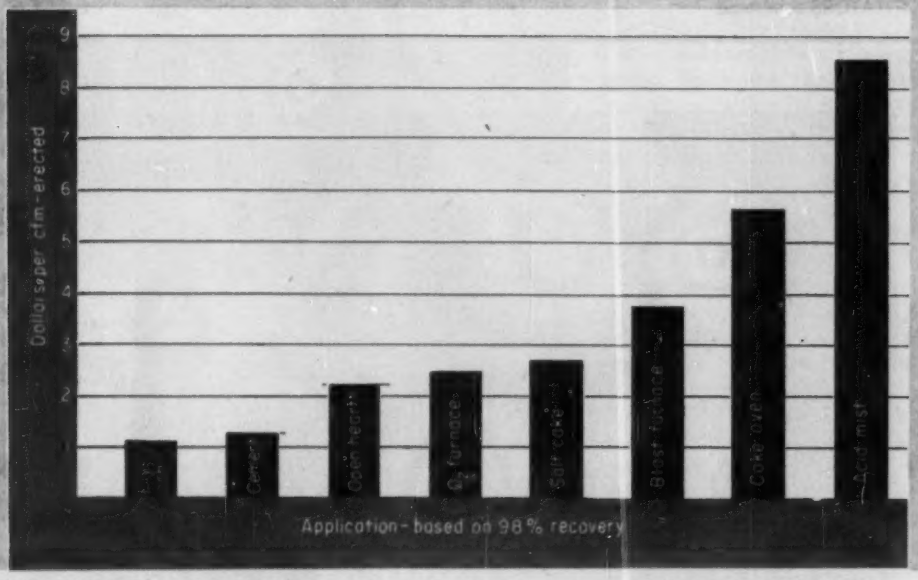


EQUIPMENT COST may vary widely depending on the corrosive nature or dust loading of material handled

Getting dust-collection and gas-cleaning efficiency is both an art and a science. Here are variables you must consider in . . .

Choosing your electrostatic precipitator

By E P STASTNY, Koppers Co, Inc, Metal Products Div

Cleaner Air Week was observed in many areas across the country during the fall of 1959. Far from being a sort of "Be kind to your web-footed friends" week or similar stunt dreamed up by a publicity man, this was serious business. Primary purpose was to focus on fact that each of us has a job to do if we are to avoid being strangled in an atmospheric garbage dump. Spotlights were turned on the gigantic strides being made on the road back to cleaner air.

Utilities and private industry are most anxious to have their efforts appreciated, and rightly so, because in the public's mind their power plants have long been the chief source of atmospheric contamination. This idea is subject to debate, particularly in some areas today, but fact remains that there will be no letup in their continued fight against pollution.

During the past decade utilities and private industry bought approximately 50% of all electrostatic precipitators sold, solely for removing flyash from coal-fired boilers' waste gases. Balance of precipitator purchases went to steel, rock-products, paper, chemicals, mining, nonferrous-metallurgical and miscellaneous industries, listed here in dollar-volume order. Many of these industries are either reclaiming gases for fuel or cleaning gases from noncoal-fueled boilers.

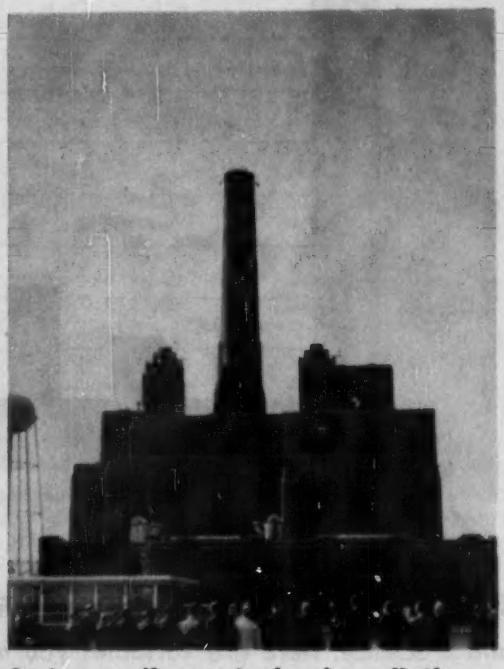
Most companies using electrostatic precipitators in connection with coal-fueled power generation are doing so to maintain public good will, fulfill civic responsibility. There is little or no money return in recovery of precipitated materials. Thus, since the annual precipitator sales market is from $15 to $30 million, some $7.5 to $15 million is spent for equipment which will not show any return.

Obviously, those charged with responsibility for precipitator selection must know design and dollarwise advantages and disadvantages.

Basic theories of electrostatic precipitation are generally familiar. However, these theories are reliable and reproducible only in lab-scale tests. Commercial application does not closely follow lab formulas because theories contain no definable terms to account or compensate for many variables met in the field.

What are these factors, how do you recognize them, how do you compensate for or correct them? Ten years ago there would have been no answer, but experience has taught us a great deal. Let's consider some variables external to the precipitator which affect the theories and, consequently, commercial costs of precipitation.

Performance desired and relative costs. Buying precipitators for recoveries under 80% is an expensive venture and is rarely considered unless other cleaning equipment isn't



Demonstration shows how modern industry easily controls air pollution

A highlight of the nation's observance of Cleaner Air Week was this demonstration at one of Baltimore's largest manufacturing plants. At a signal from city's Smoke-Abatement Engineer, precipitators were deactivated and boilers' overfire air turned off. About 45 sec later a dark brown plume showed at top of the 227-ft stack. This was allowed to continue for a minute or so. Then signal was given to reactivate overfire air and precipitators. After a lapse of 39 sec stack returned to normally clear condition. Among those watching were Federal and city officials and members of Air Pollution Control, National Coal Associations.

available or suitable. From 80 to 95% recovery equipment cost rises more or less in proportion to efficiency rise. But going from 95 to 98% calls for approximately 50% more equipment at a cost addition of 35%. For efficiencies from 98 to 100% prices are quite high, principally because of allowances that must be made to assure continued high efficiency, see curve, p 64.

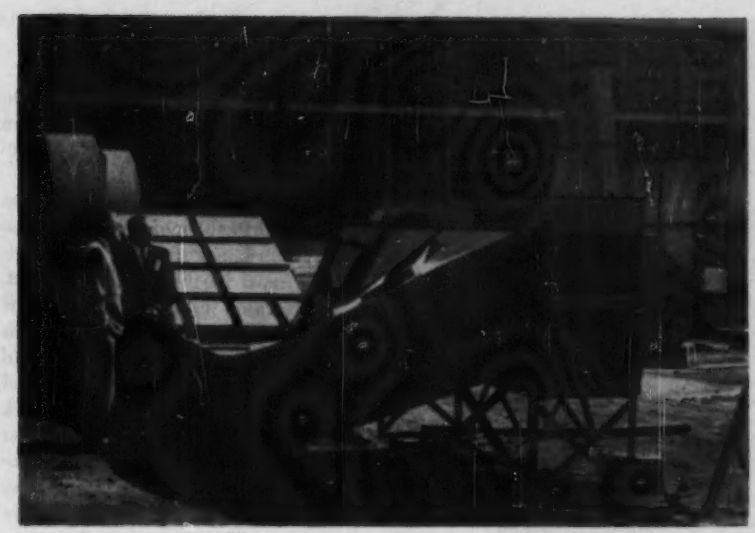
Costs are competitive with other equipment capable of yielding comparable efficiencies when large gas volumes are considered — 400,000 cfm or more. For these large units, equipment price ranges from 40 to 60¢ per cfm of gas, plus another 20 to 30¢ per cfm for installation. This does not include ductwork, dust-removal equipment, insulation or other auxiliary items.

Average equipment cost is $1 per cfm for gas volumes ranging from 100,000 to 400,000 cfm. But cost variations from 50 to 100% are not uncommon between applications handling different materials of varying dust loading, chart, p 61. Add extremely corrosive gases, making linings or other expensive construction materials a must, and you can expect cost jumps of 200 to 300%.

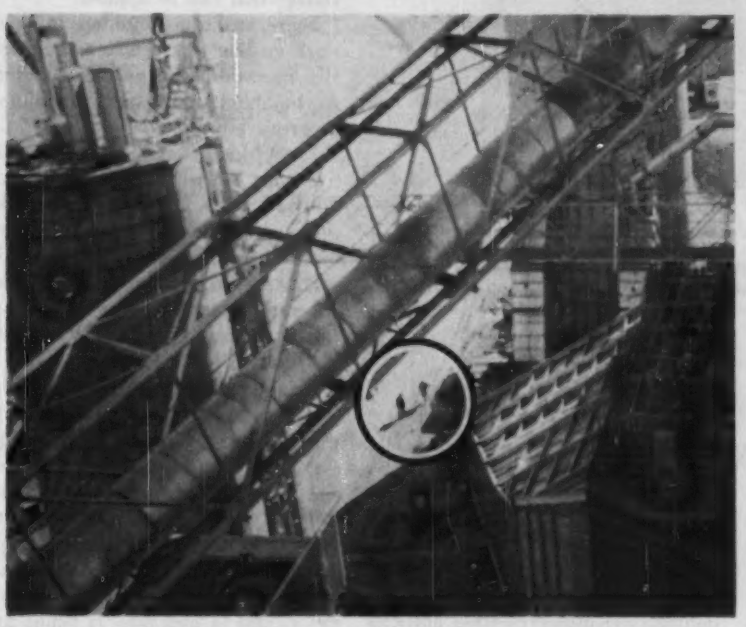
For small gas volumes—50,000 cfm or less—costs are disproportionately high because power-equipment and engineering costs (if unit is not off-the-shelf) represent a big bite.

Factors affecting size. The higher the recovery efficiency required, larger precipitator's treatment zone must be to get it. Size increases in several ways: (1) Slowing gas velocity through the precipitator by upping lane area. (2) Increasing gas-treatment time by making fields larger—most economical approach may be either of these or their combination. (3) Sectional energization of several fields in series. This allows higher power inputs in each succeeding field for bettter recoveries, also lets you cut power from a section if a fault develops, yet get relatively high efficiency from energized sections.

Secondary factors affecting precipitator size are: (1) Limiting power



MODEL STUDIES made of projected installation permit designers to accurately predict performance efficiencies. Actual unit will have same gas-stream approach and distribution



UNDER CONSTRUCTION at job site, precipitator dwarfs men, *circle*. Giant version of model above, this unit is another weapon in industry's battle for air-pollution control

equipment in relation to demand. Precipitators are sized to use as much as possible of power system's rated output. (2) Discharge- and collecting-electrode system arranged so as not to exceed rapping mechanism's ability to remove collected material. (3) Space limitations in overall plant layout. This sometimes causes uneconomical sizing to make precipitator fit, yet give you the efficiency you require.

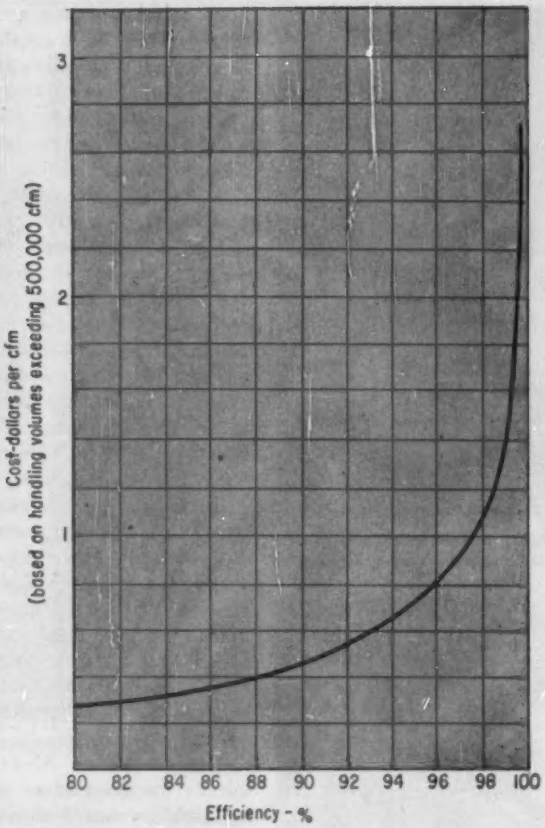
Rectifiers. Precipitator efficiency depends on a high-voltage dc source (30,000 to 70,000 v). Though voltage is high, current input to any one precipitator rarely exceeds one amp. Dc means using rectifiers. Years ago, mechanical rectifiers were used almost exclusively. Majority of today's precipitators have vacuum-tube rectification and even these are being outmoded. Many new installations will be equipped with solid-state rectifiers which, due to competitive initial cost and nil maintenance, will be more widely adopted as time goes by. (For a rundown on solid-state devices, see POWER's special report, *Electrical Conversion*, Dec 1959, pp 74-78).

Gas composition. Occasionally we run into combinations of gases and conditions that adversely affect precipitator performance. Electrical conductivity of gas and dust may be affected, causing back discharge and excessive dust swept back into gas stream—we say the dust has "high resistivity." This doesn't happen often, but when it does, it's serious. There is little that we can, or would want to do to change composition of gas coming to the precipitator—this would upset boiler's operating balance and efficiency. However, if manufacturer knows these conditions before sizing the precipitator he can make size or auxiliary-equipment changes to offset expected adverse effects.

Temperatures. About 300 F is usually the temperature specified for handling dry dust. Unfortunately, this coincides with peak-resistivity temperature of most dusts. Temperatures above or below this tend to lessen resistivity. But lower temperatures bring acid and water-vapor dewpoints into the picture and we face costly corrosion problems or use of costly materials to minimize them. Higher temperatures may better collection efficiency but they also mean heat loss. As a result, most precipitators operate at peak resistivity. Saving factor is that only a small percentage of these peak values fall into ranges that hurt performance.

Pressures. Gas pressures for most precipitators run within ± 30-in. water. Unless service involves extreme pressures above or below atmospheric, special designs aren't needed.

Fuels. High-sulfur fuels (2 to 4%) yield quantities of SO_2 and SO_3 favoring electrostatic precipitation. Higher sulfur tends to make collected dust sticky, generally requires more rappers than are normally used. This sticky, caking characteristic may mean difficulty in knocking the collected ash loose from precipitator plates as well as moving it from hoppers for disposal. Moral: Fuels' sul-



PRECIPITATOR COSTS are proportionate to efficiency rise from 80 to 95% recovery. Above 98% efficiency, cost climbs rapidly

fur content must be considered in precipitator-performance equations.

Water vapor. Amounts between 5 and 10% by volume are helpful in reducing ash resistivity. Above 10% water vapor there's no appreciable resistivity drop but added moisture does lessen dust re-entrainment during rapping cycles. Moisture content isn't objectionable until it makes dust pack and hard to dislodge from collecting components.

Dust loading and characteristics. Generally, the greater the dust load, higher precipitator's efficiency must be to hold residuals to proper limits. To do this with least possible equipment, designers turn to sectioning—independently powered series fields. Higher power inputs to succeeding fields up efficiency along the line—particularly important with very-high dust loadings which are apt to cause erratic operation of entry field. By having independent connections, field to power source, first field's behavior can't affect others'.

Dust-particle size range usually isn't important. But if there's a quantity of submicron-sized particles we have to consider possibility of denser packing when they're collected. We may want to provide extra rapping, keeping in mind possible re-entrainment problem when ultrafine particles are knocked loose from plates.

Dusts tending to build up on boiler tubes and ductwork show similar characteristics within an electrostatic precipitator, and this makes for difficult removal from collecting surfaces. Unless we have enough rappers to clean small areas completely, we aren't going to get a good cleaning job. Excessive buildup means frequent arc-over which forces us to reduce input voltage to keep unit on the line, and voltage cut lowers precipitator's overall efficiency.

Ductwork design. One of the cardinal principles of good precipitator performance is that gas distribution must be uniform at the inlet. High volume concentration in one area means excessive velocity. This can make the electrodes swing and arc, seriously scour components and sweep already collected dust back into the gas stream. On the other hand, static (no-flow) areas are subject to abnormal arcing caused by overstressing static gas between wire and plate. This lowers performance because it reduces optimum normal voltage that can be applied.

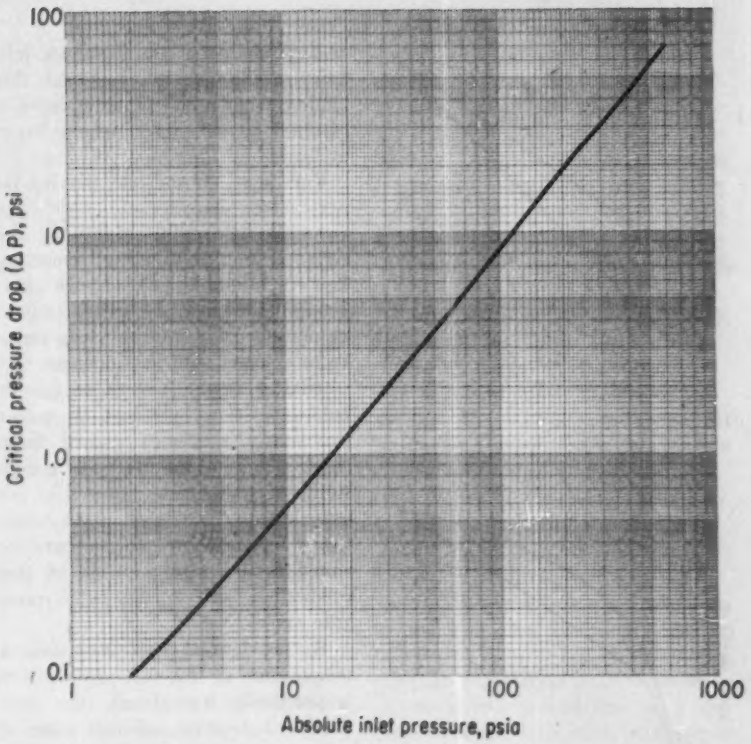
Segregated dust buildup in ductwork leading to a precipitator generally means uneven gas distribution. As buildups grow, gas distribution progressively gets worse.

Every design engineer has a relative idea of what he's paying for pressure drop. Poor ductwork design, which means poor gas distribution, certainly raises cost. At $5000 per yr per in. water per 100,000 cfm (operating cost based on 1 mill per kwhr) we can't afford to pay for poor distribution.

Many layout engineers consider only capital cost when making ductwork layouts. First thought, understandably, is to connect gas source and precipitator with shortest runs possible. But it's highly important to go a step farther, get best-possible approach to the precipitator. Bends in ductwork ahead of unit can throw gas stream to one side. If bends are unavoidable, trick is to straighten the gas stream with vanes and perforated plates. Almost foolproof scheme is to have a model built and run gas-distribution studies—cost of model is insignificant compared with results.

Most precipitator purchasers fully appreciate the importance of good gas distribution. Quite often they lay this problem right in the lap of the manufacturer, making him responsible for design and layout. Through pilot study, manufacturer comes up with data telling him exactly how the installation will perform. Of course, he covers this in his quotation.

By J R BERMINGHAM, Manager
Utility Application Engineering
Leslie Co



CRITICAL PRESSURE DROP becomes an important basic design criteria when sizing control valves for flashing service. Curve applies to operation of any throttling valve

Final part of this article on heater-drain controls will help you choose the proper valve characteristics and flow coefficients. Keep this round-up of design techniques handy to show you . . .

How to pick heater-drain control valves

Heater-drain controls become an extremely important part of overall cycle control systems, as modern plants strive for maximum heat recovery. To obtain optimum heat recovery over the equipment's entire load range, drain-control system and individual components must be carefully matched.

Part 1 of this article (POWER, Dec 1959, pp 91-93) covered basic control systems for three general heater-drain arrangements. This month we supply basic know-how for sizing heater-drain-system control valves and selection of valve materials—all with an eye toward producing the best possible match between characteristics of system and components.

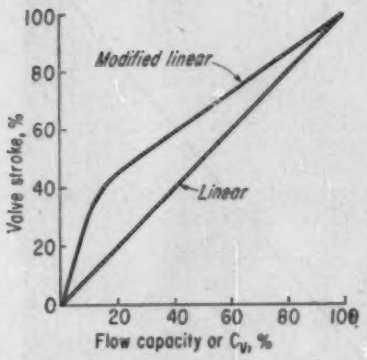
A simple, 3-step program of control-valve selection would consist of: (1) determining required valve characteristics (2) sizing valve internals (3) selecting valve materials for anticipated service.

Main criteria for establishing control-valve characteristics after proper selection of control equipment and determination of control functions that the condensate-control system is to perform are generally limited to four situations. (In descriptions of valve characteristics for specific systems refer to Part 1 for control diagrams.)

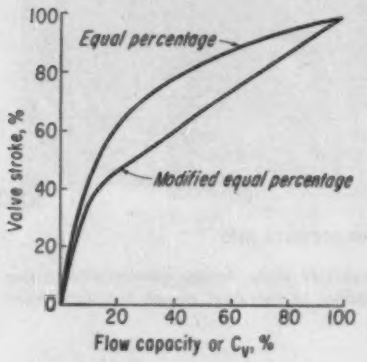
For control system 1, where flow and pressure drop increase and decrease together as load changes and rangeability requirement is below 10:1, a linear characteristic is theoretically acceptable because this system is naturally stable and tends to be self-regulating. However, the linear characteristic becomes somewhat unstable under low-load conditions because it can create rapid level depression when the valve strokes at a rate normal for higher loads. We can say it has a constant unit sensitivity throughout its travel which may be satisfactory for higher loads, but may be too sensitive for stable control at low loads. This could require a change in sensitivity of the control system for low-load operation.

Modification of the linear characteristic as shown, next page, can elim-

Valve selection demands knowledge of characteristic



LINEAR-VALVE characteristics can be modified to reduce low-load sensitivity



EQUAL-PERCENTAGE characteristics may give you trouble with high-load sensitivity

inate this problem and is particularly advantageous when same control-system sensitivity is used for all loads.

For control systems 2 and 3, where pressure drop increases as flow decreases and rangeability requirements are 25:1 and more, equal percentage characteristic is theoretically acceptable because it can throttle down to the lower C_V reuirements. Under these circumstances, however, the equal-percentage characteristic becomes somewhat unstable under high-load conditions because it creates a very high rate of change of flow for a normal stroke change; we may say its unit sensitivity increases continually with travel. This also could require a change in sensitivity of control system for high-load operation.

A modification of the equal-percentage characteristic as shown, left, below, will generally reduce this tendency and aids in maintaining a constant control-system sensitivity at all loads.

Curves at left indicate that an inner valve characteristic which incorporates throttling ability of the equal-percentage valve and constant-flow vs constant-stroke-change characteristic of the linear valve tends to reduce need for control-system sensitivity changes with load changes.

Sizing inner valves to handle cold-water flows presents no major problem. Experience gained from original rules of the "art" and a multitude of applications, as well as lab experiments correlated with established formulas for orifices, have resulted in accurate methods of size prediction for relatively wide pressure ranges.

We are defining *cold* water as at a temperature so low that vaporization is practically nonexistent (less than 80 F). *Subcooled* indicates water at a temperature below saturation, but not far enough to preclude vaporization during throttling process. *Saturated* refers to water at temperature of vaporization at a given pressure, but 100% in liquid state (additional heat would cause vaporization at same temperature and result in flashing mixture). *Flashing mixture* refers to liquid-and-vapor mixture with some transition of liquid to vapor.

Calculations evolve from conventional flow-coefficient formula, C_V:

$$C_V = \frac{gpm\sqrt{sp\ gr}}{\sqrt{\Delta P}}$$

This produces reliable results for cold-water calculations. ΔP is taken as differential in pressure between inlet and outlet of the valve.

Increasing use of high-pressure high-temperature water and condensate, however, presents problems not normally encountered with cold water. At water temperatures above 80 F you must consider flashing during pressure reduction. Since flashing represents a considerable increase in volume, its effect is extremely important. Let's look at some facts:

Thermodynamically, percentage of flash (vaporization) can be calculated from enthalpy at the inlet condition and final conditions. Assuming flashing takes place entirely within the seat, you can calculate required seat area for combined total flow of liquid and flash.

This calculation considers that thermodynamic equilibrium takes place instantly, and complete reduction of pressure occurs in the valve-seat area. Experience has not entirely justified this consideration, and while valves sized on this basis generally handle flow conditions, they are often larger than necessary and not the most economical choice.

Experiments show that flow rate of saturated liquids increases with increased pressure difference up to a maximum value, after which flow rates stay constant regardless of further increase in pressure difference.

Basic thermo calculation for flashing liquid results in a maximum flow. After that, flow should decrease with added pressure drop, since larger area required by increased volume of vapor at the lower pressure leaves much less area for liquid flow. But flow does not decrease, so we modify the basic thermodynamic relationship to agree with fact.

By establishing mathematical formulas from thermodynamic properties and comparing them with results obtained in actual installations and lab tests, we can predict pressure drop to produce maximum mass flow for each inlet pressure.

Pressure drop determined this way is referred to as a *critical* pressure drop for saturated liquids (ΔP critical). Valve capacity may be determined if the C_V factor of the valve, determined by standard methods, is used with the critical pressure drop. This capacity adequately provides for flash.

Modified sizing methods are based on the following assumptions: (1) Sufficient head exists at inlet to prevent flash at entrance of valve and throat. (2) Completely metastable flow does not exist and fluid consists of a liquid core surrounded by rings of vapor. Vapor forms between the interface of the fluid and walls of the

curves, capacity control range and service severity

throat. (3) Velocity and pressure are uniform throughout any cross section of the stream and mass flow of vapor is small relative to mass flow of liquid. (4) Flow rates per unit area increase with pressure difference up to a maximum value, after which flow rates remain constant regardless of further increase in pressure difference. (5) Capacity of discharge piping is adequate to pass desired rate of flow.

Sizing calculations based on these assumptions differ for saturated and subcooled water. To illustrate this difference, let's follow through sample calculations for each case.

Saturated water or condensate

1. Enter first curve at inlet pressure and find ΔP critical for this condition
2. Compare with actual drop (inlet – outlet pressure)
3. Use smaller drop from steps 1 and 2 and calculate C_V by standard formula

Example: for saturated liquid, inlet pressure = 100 psia, inlet temperature = 328 F, outlet pressure = 20 psia, flow = 50 gpm

1. From steam tables, 100 psia, 328 F = saturation
2. From curve, ΔP critical = 8 psi
3. Actual pressure drop = 100 – 20 = 80 psi
4. Since ΔP critical = 8 psi is smaller than actual drop of 80 psi, use this to determine valve size:

$$\text{Required } C_V = \frac{\text{gpm}}{\sqrt{\Delta P}} = \frac{50}{\sqrt{8}} = 17.7$$

Subcooled liquid

1. In this case, liquid will not begin to exhibit tendency to flash until pressure drops to the saturation point. If outlet pressure is above saturation pressure the conventional method based on full pressure drop may be used to calculate required C_V. If outlet pressure is below saturation pressure, determine difference between actual inlet pressure and saturation pressure corresponding to inlet temperature (from the *Steam Tables*)
2. Find ΔP critical corresponding to saturation pressure at inlet temperature (from curve, p 65)
3. Using the larger drop found in 1 and 2 calculate required C_V by conventional formula

Example: for subcooled liquid, inlet pressure = 100 psia, inlet temperature = 270 F, outlet pressure = 20 psia, flow = 500 gpm

1. From *Steam Tables*, saturation pressure for 270 F = 42 psia and final pressure is below this
2. Difference between actual inlet pressure and pressure corresponding to outlet temperature = (100 – 42) = 58 psi
3. ΔP critical corresponding to 42 = 2.95 psi
4. Larger pressure drop in step 2 is used to find C_V

$$\text{Required } C_V = \frac{500}{\sqrt{58}} = 65.8$$

With valve size fixed, you are ready to select valve materials.

Material selection for valve body and trim has been on the basis of satisfactory experience under specific service conditions.

In flashing service, destruction of the material usually is the result of combined corrosive and erosive action. It often is impossible to determine which action does the greatest part of damage as one accelerates the other.

Corrosion, a chemical action, increases with rising temperature. Corrosive products tend to be more bulky and weaker than the base material, but protect metal, prevent further corrosion as long as they remain intact.

Lower-grade alloys usually have higher corrosion rates and bulkier, less-protective corrosion products having a weaker bond with the parent metal than those formed by higher alloys.

Erosion, a mechanical scouring action, increases with velocity and tends to wear away the material surface. Generally, increased erosion goes with lower alloys and weaker film-to-base-metal bonds.

Erosion is also furthered by concentrated work-hardening or physical damage of the surface by abrupt direction changes of high-velocity streams, abrupt changes in part contours or collapsing of voids due to flashing. In addition, as corrosion progresses, surface becomes honeycombed by pitting and erosive action increases.

Obviously, higher alloys with more corrosion resistance and better physical properties as far as erosion is concerned are better materials to choose for valve bodies, but these alloys are considerably more expensive so it is desirable to use them only where necessary. Accurate calculations to determine this are not practical, so experience usually is the factor determining choice of material.

Data sheet, p 92 of this issue, can serve as a guide for selection of body material where no specific experience is available—tear it out and attach to this article in your file. Chart, based on past experience, represents very conservative applications of materials. Future operating experience may result in reducing high alloy requirements. To find material, enter chart with values of fluid flow and valve body size. Intercept represents fluid velocity, as shown by diagonal lines. Extend velocity parallel to plotted constant-velocity lines to intercept anticipated operating conditions. Note separate steps in materials, operating conditions so no overlap is possible.

For inner valves and seat rings, stellited 18-8 stainless steel or stellite is best.

Final valve selection, considering valve characteristics, valve size and valve materials, must also fulfill requirements stated in Part 1 of this article. Basic factors were:

(1) Cycle should start, rise to full load and shut down with all heaters in service.

(2) All heater controls must function properly through all load changes and even under full-load trip-out.

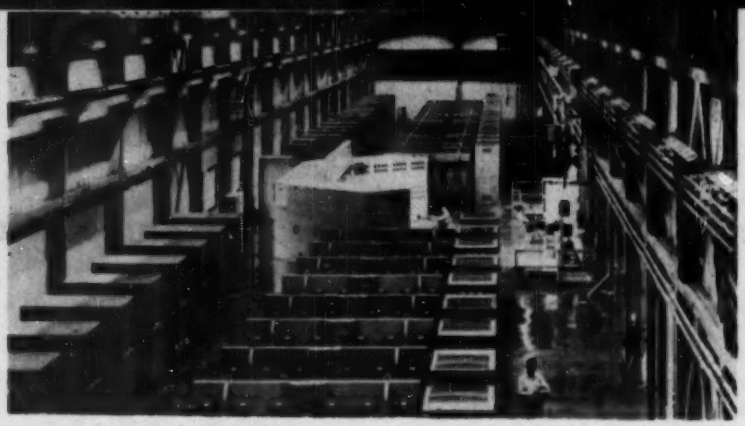
(3) Bleed valves must not trip.

(4) No high-level or low-level alarms regardless of load or transients.

(5) Controls must operate over long periods of time with minimum of adjustment and maintenance on the part of operators.

NO. 19: DC DISTRIBUTION

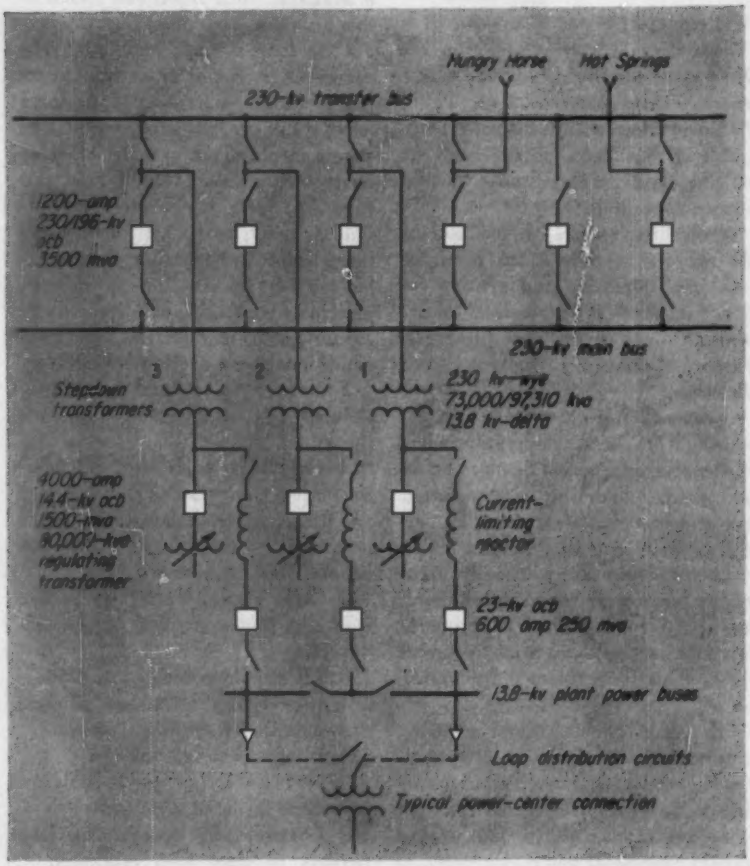
Power to grow ...electrically



RECTIFIER BANKS for two pot lines have control cubicles on the right, breakers at left

This system has built-in dc continuity plus PTG

By C J LUNDBORG, The Anaconda Company
and A W POSSNER, Westinghouse Electric Corporation



TWO UTILITIES provide alternate sources of power to the 230-kv switching station. Spare breaker can be substituted in supply lines or feeders through the transfer bus

When it comes to designing an electrical-distribution system to assure continuity of direct-current power, probably no industry is more exacting in its requirements than the aluminum-reduction process. Loss of dc power for more than a few hours will result in "freezing" of the molten bath, with loss of production and materially shortened pot life. At the same time provision must be made for *Power to grow* to meet needs of this rapidly expanding industry.

The Anaconda Aluminum Company's plant at Columbia Falls, Mont. was designed for maximum continuity of power by company engineers and the Westinghouse Electric Corp. Two 30,000-ton aluminum pot lines have been in operation for about four years, each supplied by a 100,000-amp 700-v dc ignitron rectifier. These two pot lines take about 1,100,000 mwhr annually from the 230-kv utility supply system. With a few field revisions, system has worked well.

Alternate sources with standby capacity are provided by the 300,000-kw Hungry Horse Dam hydro station, seven miles away, and a 50-mile 230-kv line from Hot Springs utility sub.

Switching station at plant, left, is a conventional double-bus arrangement using a transfer bus and a spare circuit breaker. Breaker can be substi-

tuted in either of the two incoming-line circuits or any of the three feeder circuits. Bus-differential, line-impedance and carrier-current relaying protect substation and lines. Instantaneous automatic reclosing maintains continuity through this loop station on the utility system. With either incoming line in service the plant can operate at full capacity. Control-room operators switch 230-kv as directed by the utility dispatchers.

Stepdown facilities match reliability of primary supply. There are three 73,000-kva 3-phase transformers, each rated 97,310-kva forced air, adequate for one pot line and all plant power. Any two can carry complete plant load. Differential relays provide internal-fault protection. Separate grounding transformers are used to detect grounds on the 13.8-kv circuit, permitting continued operation with a ground on the system while fault is being located and repaired.

Regulating autotransformers, each 80 mva, are normally used to supply the two 100,000-amp pot-line rectifiers. An additional 12,500-amp rectifier unit can be installed in future to increase pot-line output; regulators will take forced-air cooling fans to meet increased load. Each regulator has seven no-load taps and a 32-step load-tap changer; operator can control the dc bus voltage from 700 v to less than 100 v in 4-v steps by remote control. Vernier control is by ignition-delay of individual rectifiers.

Transfer of either pot line to the duplicate standby circuit (transformer No. 2) can be made. Primary breaker for this circuit is normally open. No-load taps on the standby transformers are set to match positions on operating units so standby circuit is immediately available.

The 13.8-kv loop distribution circuits for nine power centers supply 13,000 kva of 480-v power at various plant locations. Ends of loop can be energized from secondary of only one of the three stepdown transformers at any time. Each power center includes a 5-position selector switch to permit isolation from the loop or alternative connection. A 1000- and a 1500-kva unit substation are similarly connected to the 13.8-kv loop distribution system to supply 2300 v for the larger motor loads.

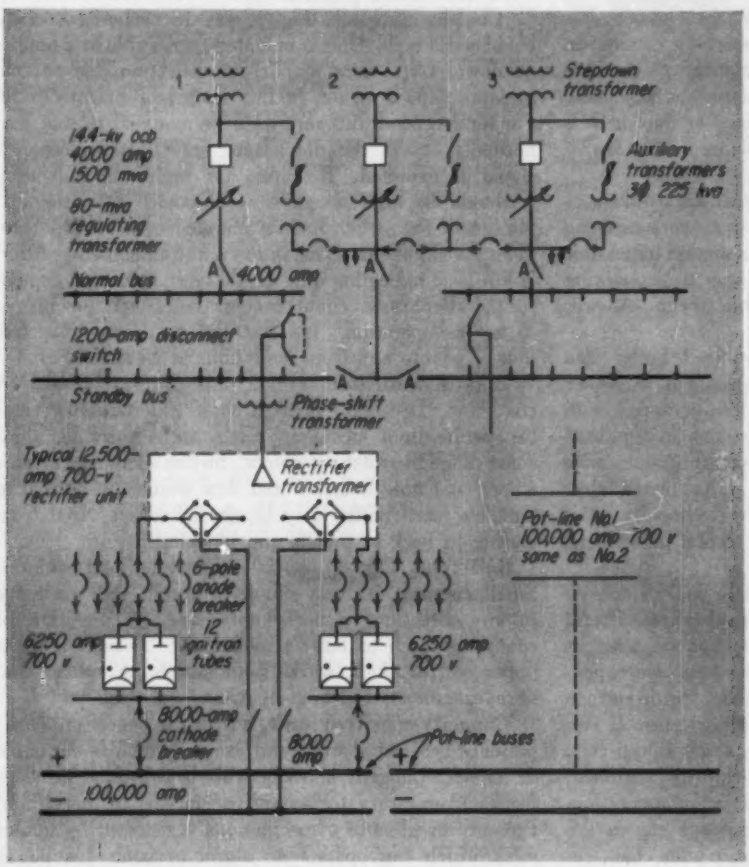
Double cables provide standby capacity between stepdown transformers and plant power-switching bay, and between auxiliary transformers and indoor l-v auxiliary switchgear.

Rectifier auxiliary power is provided by three 225-kva auxiliary transformers; one supplies 230 v for excitation and auxiliary circuits, other is standby. Indoor l-v switchgear connects transformers to bus ducts with plug-in molded-case circuit breakers to distribute power to the individual 6250-amp rectifier assemblies. The two circuit breakers in the standby-transformer secondary are used to connect it to either duct.

Rectifier-transformer primaries can be switched between a normal and a standby 13.8-kv bus. The switches are mechanically interlocked. Each 100,000-amp 700-v-dc pot-line rectifier consists of eight 12,500-amp units, each with two 6250-amp 12-tube pumped ignitron rectifier banks connected to the 6-phase parallel double-wye transformer secondary. Phase-shift transformers are connected in the primary circuits of six of the eight rectifier transformers for 48-phase operation with the eight units in service.

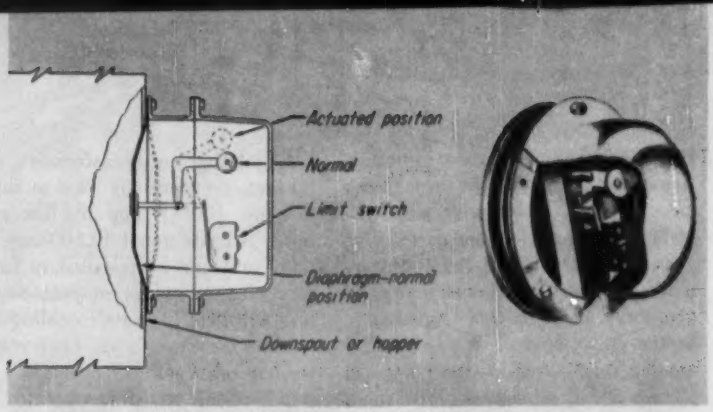
Water cooling of the 16 rectifier power transformers eliminates about 200 radiators. If water supply fails the transformer will operate safely at rated load for one hour, or for two hours if load is reduced to 70%.

Centralized control originates in 19-section duplex switchboard which controls, supervises and protects the common plant circuits. Mimic bus-board above the center sections of the switchboard shows arrangement of power switching circuits in the outdoor sub. A "scrutinizer" desk at this plant includes all recording instruments and integrating meters for the pot-line rectifiers and plant load. An operator stationed at this desk continuously controls plant load to be sure it never exceeds demand limit.



DUPLICATE STANDBY circuit consists of stepdown transformer No. 2 and its associated regulating and auxiliary transformers. Primary circuit breaker is normally kept open

By ARTHUR J STOCK
Stock Equipment Co
Cleveland, Ohio



1 Diaphragm mounts on side of hopper or downspout, coal pressure deflects it. Deflection, opposed by counterweight, actuates switch in alarm or control circuit

Stoppage alarms and level controls are a must in today's automatic dust-tight systems. Here's a lineup of . . .

Watchdogs for coal-handling systems

Yesterday, men stood watch at transfer points on the coal-handling circuit to check on stoppages. Dust at some of these stations made for miserable working conditions. Today, dust-tight coal-handling equipment needs little or no manual operation. Mechanical or electrical controls and alarms monitor coal's presence or flow at various points to satisfy the tremendous coal appetite of modern boilers.

Such controls and alarms can prevent hazardous conditions due to interrupted flow. With conveyors carrying hundreds of tons of coal per hour, it's almost impossible for an operator to spot trouble and stop the conveyors quickly enough to avoid a considerable pileup. Answer lies in continuous automatic policing.

Fuel stoppage to a pulverized-coal-fired boiler can mean explosive conditions as well as a cut in boiler capacity. This is why many boilers are equipped with an extra pulverizer; if coal stoppage occurs on one, load may be transferred to another. However, maintenance schedules may make the standby units unavailable. Worse, conditions stopping coal flow frequently exist simultaneously in the feed systems to several pulverizers, shutting down the entire unit.

The modern large boiler unit receives coal in considerable tonnages at a few closely grouped points. Useful length of bunker is limited, so it must have great height to hold a reasonable supply. Such bunkers are expensive, and trend seems to be toward smaller inside storage and continuously operated coal-handling systems. If systems must be automatic to reduce the plant's initial cost, absolutely reliable coal-level and flow-control instrumentation becomes necessary to insure continuous operation.

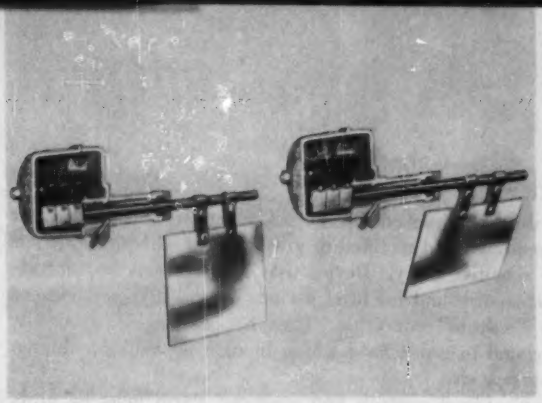
Efficient coal-level indicators and stoppage alarms are available. Major types are diaphragm, paddle, ball, rotating, electronic (capacity sensitive), turn counting and sound or vibration. First five indicate presence or absence of coal at a point, the rest show coal flow directly.

Coal-level switch, Fig. 1, was the earliest successful commercial type. Unit is mounted on the side of a hopper or downspout where diaphragm deflection due to coal pressure flips a switch in the control or alarm circuit. For level control, this unit must be mounted so that coal normally covers the diaphragm only partially when a signal is expected. However, for high-level indicating it should be low enough so coal could cover the diaphragm if the switch hadn't operated earlier. This provides for slight variations in the required actuating force. A low-level indicating unit should be spotted high enough so the diaphragm could become completely uncovered to assure operation. It's essential to provide for free flow of coal to and from these units at all times.

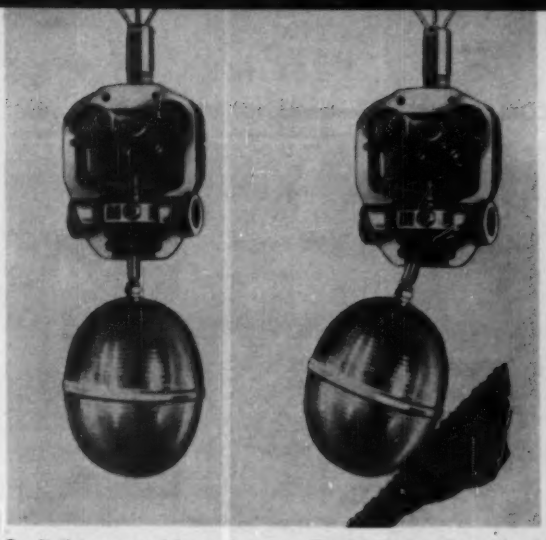
Paddle indicator, Fig. 2, has paddle deflected by coal flow. Deflection turns a shaft which rotates cams to operate limit switches. Cams are adjustable, allow some range in switching points. Switch should be located where coal flow is active and flow should be normal to paddle's face. Baffles may be needed to keep coal from getting in back of paddle and blocking it.

Ball type, Fig. 3, also is actuated by coal surfaces. Small, compact, it's very simple to install. Ball can move in any direction in horizontal plane, so direction of coal's approach to ball is immaterial. Deflection cocks upper end of shaft, works limit switch. A rubber diaphragm protects the housing from coal dust.

Capacity-sensitive unit, Fig. 4, depends on coal's presence between a probe and ground which is the chute or hopper. Capacity between probe and ground provides feedback necessary to sustain oscillations in the circuit. Presence or absence of oscillations is detected by output relay which can operate an alarm or control a power relay. Sensitivity is adjustable; it's desirable to set it as low as possible to get reliable indication despite up-



2 Coal deflects this unit's paddles, causes shaft movement which rotates cams, actuates switches to indicate presence of coal



3 Ball is actuated by coal surface. Direction of coal's approach is immaterial since ball is free to move in horizontal plane

setting influences such as dust accumulation or large temperature changes. Another device, not shown, works in similar manner but is much larger and heavier. Probe is usually mounted at the end of a vertical pipe which surrounds and protects cable to probe. Both units are available in two forms so as to have a "fail-safe" condition regardless of application. Since they're electronic it's necessary to protect the control chassis from vibration and high ambient temperatures. Regular maintenance schedule of tube replacement is a must.

Motor-driven unit indicates coal presence when a rotating vane is stopped, Fig. 5. Motor and pinion are mounted on a floating disk not directly connected to geared vane shaft. A compression spring and stop determine disk's normal position. When coal stops, vane's rotation stops, too. Since motor is still energized, the disk, on which motor and pinion are mounted, rotates around drive gear. This compresses spring, flips limit switch controlling alarm circuit. When vane is freed, spring returns disk to normal position and limit switch opens. Action depends only on coal being present, not on coal's surface developing pressure.

Turn-counting type of coal-flow alarm, Fig. 6, differs from those above in that it monitors flow, not just coal's presence. It polices entire flow circuit from bunker to pulverizer. Necessary item in circuit is an automatic coal scale because the alarm depends on scale's operating in proper relationship to the pulverizer feeder.

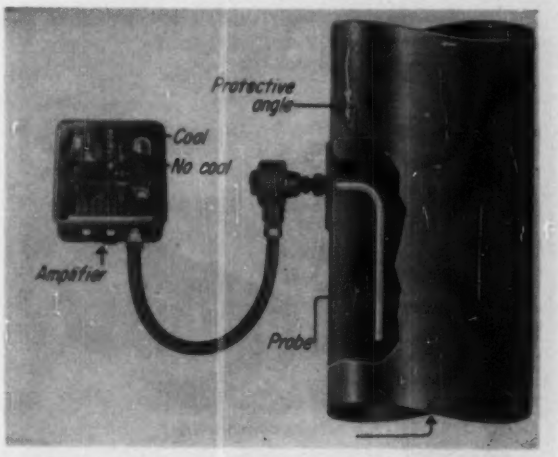
Usual bunker-to-pulverizer setup has a bunker-outlet coal valve, automatic scale and a pulverizer feeder. Feeder must discharge a predetermined volume of coal per turn of feeder shaft. Scale weighs out a definite batch per cycle. If scale's capacity is 200 lb and if feeder discharges 100 lb per 11 turns, then:

22 turns of feeder shaft = 200 lb coal ± 10%

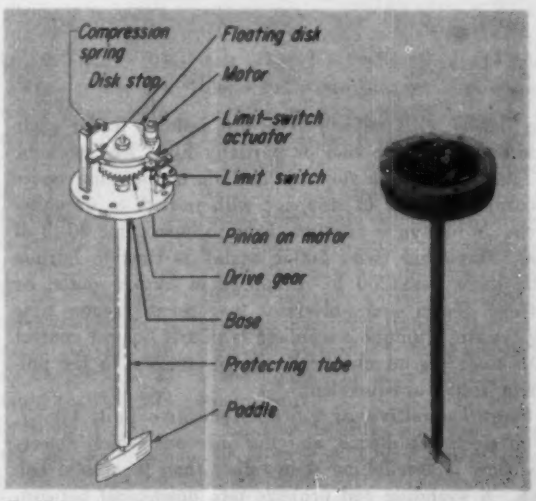
One dump of scale = 200 lb coal ± ¼%

So: 22 (± 10%) turns of feeder shaft = one dump of coal

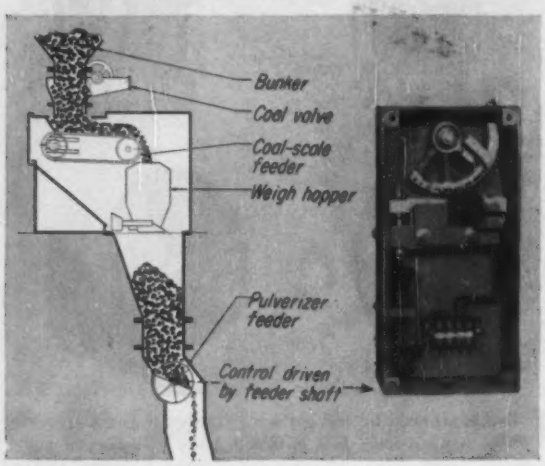
These relationships hold so long as coal is flowing. If stoppage occurs, feeder makes an abnormally large number of turns for one dump of the scale; in this example, 25 or more turns would surely indicate stoppage. It could be at bunker outlet, scale inlet, scale-outlet hopper, pulverizer-feeder inlet or in downspout between feeder and pulverizer. If the latter, feeder shaft rotates without discharging coal. With some feeders, turn-count-



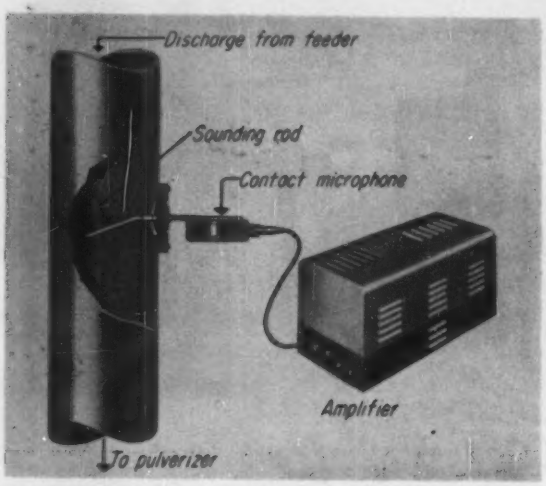
4 Capacity-sensitive device depends upon coal presence between a probe and a ground which is the surrounding steel



5 This motor-driven unit's action depends only upon coal being present, not upon the coal's surface developing any pressure



6 This alarm device monitors flow, not just coal presence. It can police entire flow circuit from inside bunker to the pulverizer



7 Vibration-sensitive device is the only one which detects flow when coal is in a free-falling state rather than a solid column

ing device will indicate sheer-pin failure, feeder plate skidding under the coal or partially filled feed pockets.

Time lag between stoppage and alarm sounding varies according to time of stoppage with respect to weighing cycle. Minimum is the time taken to burn some 20 lb of coal. Maximum (with 200-lb scale) is time to burn a little more than 200 lb. Stoppage at bunker outlet or between feeder and pulverizer may mean greater time lag. Alarm's unique advantage is that it has no contact with coal; it's merely mechanically attached to the pulverizer feeder or equivalent.

Sound-sensitive or vibration-sensitive unit, Fig. 7, is an electronic device, and the only one which detects coal flow in free-falling state rather than in a solid column. A sounding rod projects into downspout between feeder and pulverizer, is struck by falling coal. Sound vibrations picked up by an external microphone are amplified and rectified to give a signal which can actuate a sensitive relay. Device uses a time delay so that absence of sound for brief periods doesn't necessarily mean a "no-coal" condition. Unit has adjustable sensitivity related to noise level which in turn depends on falling-particle size.

Coal-level controls and stoppage alarm must be properly installed. They must be placed where there's active coal flow; indication may be false if there's any hitch in feed to and from the alarm. Example: A bin may be empty except for a small amount of coal stuck at the alarm switch—which gives a "full" indication.

Coal doesn't flow from bunkers and hoppers uniformly over a horizontal cross section, but rat-holes vertically upward from outlet. Part of bunker immediately above the outlet contains the active coal.

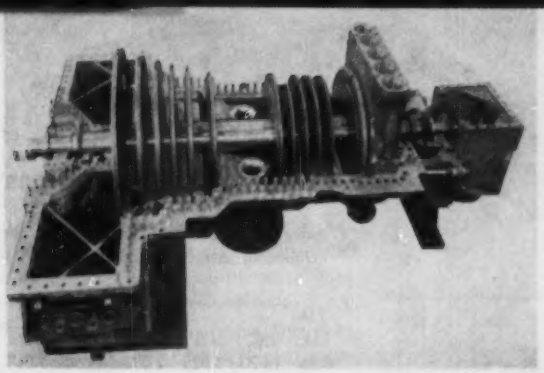
Equipment's location on bunker sidewalls can cause faulty operation. If coal rat-holes in the bunker or assumes a steep angle of repose, indicator may be unable to report true conditions. If bunker or hopper has one straight side it's easier to put the device in a good spot directly above the outlets. If feed inlet to hopper isn't immediately above discharge point, high-level coal switch should be between loading and discharge points, as close as possible to the former.

Switches can be located at any point around the periphery of small-cross-section vertical downspouts because flow is uniform. But with a large cross section, flow may be faster on one side or it may rat-hole. Fast side will be above point from which most coal is drawn and a stoppage alarm should be put above that point. Good spot for an alarm on a horizontally inclined downspout is the top surface because this is the active flow side and any void will develop there.

In transfer hoppers between conveyors where free fall exists, alarms should be spotted close to, but outside of, the main stream. If coal backs up into the hopper the switch goes right to work. Switch should be shielded from stray coal particles which might actuate it and give a false alarm.

A vitally important factor is that alarm be sounded early enough to let operators correct the fault or shut down equipment subject to damage. As a rule, alarms located to give considerable warning tend to monitor a smaller portion of the overall system, so it's desirable to have several alarms at various points.

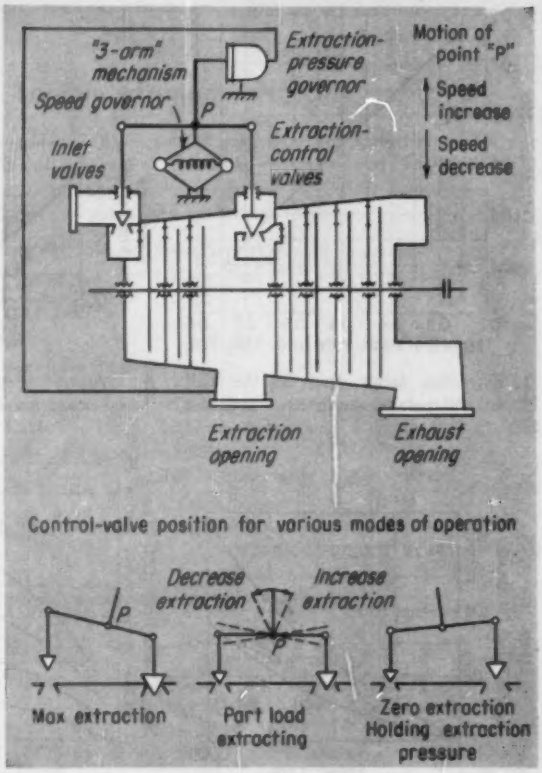
Present trend toward cleaner and more automatic coal-handling facilities will continue, increasing demand for coal-level controls and flow alarms. Manufacturers, aware of the great responsibility assumed by their devices, bend every effort to design them for absolutely reliable operation. Plant designers should carefully select the equipment which best suits their requirements and make sure through proper installation that the units will do a good job. Operating men should service coal-level switches and stoppage alarms regularly. Failure of this equipment can cause operating difficulties of far greater magnitude and scope than the small amount of work which is required for routine maintenance.



1 Partly assembled noncondensing automatic-extraction turbine with 3125-kw capacity, 3600-rpm speed and 42-in. exhaust

By RICHARD SHIFLER
Thermodynamic Design Engineer
Small Steam Turbine Dept, General Electric Co

We continue our study of predicting performances of mechanical-drive turbines. With the data given here and in preceding parts we are ready to figure . . .



2 The 3-arm mechanism co-ordinates extraction pressure, turbine shaft speed and also the turbine-inlet or throttle steam flow

Noncondensing automatic-extraction turbines

Noncondensing automatic-extraction turbines consist of two noncondensing turbines in series. In contrast, the condensing type has a noncondensing turbine followed by a condensing turbine. The condensing type outnumbers noncondensing by two or three to one in number of applications.

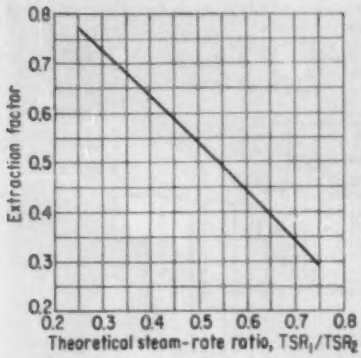
The latter turbines supply process steam at two pressures with the lower or exhaust pressure at atmosphere or higher and the extraction pressure controlled between exhaust and throttle pressure. This type is more difficult to apply than the condensing type as following example indicates.

Fig. 7 shows a characteristic for a noncondensing automatic extraction turbine similar to the one for the condensing turbine in Part 10, POWER, Dec 1959. Consider the following situation which shows why steam and power needs must be carefully matched: (1) power needed is 5000 hp (2) extraction steam needed is 100,000 lb per hr at 150 psig.

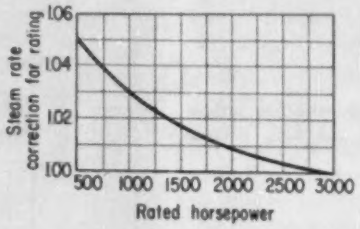
Fig. 7 shows the throttle flow is 132,000 lb per hr so the exhaust flow must be 32,000 lb per hr. If the process line fed by the exhaust needs more or less than 32,000 lb per hr, the following things may happen: (1) If the process needs more than 32,000 lb per hr, the process will be "starved" for steam (2) if the process needs less than 32,000 lb per hr, the exhaust pressure may rise until: (a) the process can absorb the additional flow (b) the exhaust relief valve blows and wastes steam to atmosphere (c) steam is purposely wasted, or (d) load on the turbine drops.

Changes of power need and extraction-steam flow independent of each other raise similar situations. For these reasons noncondensing automatic-extraction turbines are usually not the only source of power and process steam in a system. They may be supplemented by either an additional power source or an additional steam source.

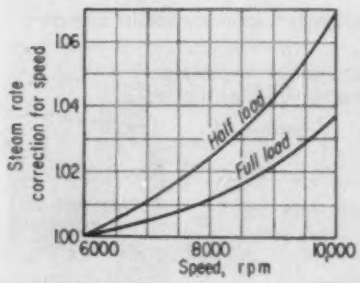
Suppose the turbine of Fig. 7 supplies a process with variable steam demand at the extraction pressure, but with a fairly constant steam demand of 100,000 lb per hr at the exhaust



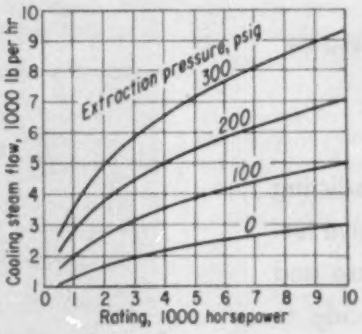
3 Extraction factor drops as the TSR ratio of parallel steam flows increases



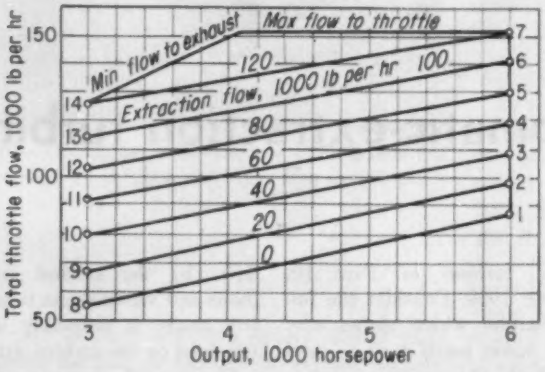
4 Comparative steam rates for large turbines are lower than for smaller units



5 As design speeds rise above 6000 rpm steam rates increase for all unit loads



6 Cooling-steam flow needed depends on both rating and extraction pressure



7 Performance of 6000-hp turbine at 7000 rpm, 600 psig, 700 F, 20-psig exhaust, 150-psig automatic extraction; from problem

Performance corrections

a. Rated-load steam-rate factor *A* for noncondensing extraction turbines

TSR_1 / TSR_2	Flow ratio* 1.0	1.5	2.0	2.5	3.0
0.25	1.020	1.025	1.035	1.050	1.065
0.35	1.022	1.027	1.039	1.054	1.069
0.45	1.024	1.029	1.043	1.058	1.073
0.55	1.026	1.031	1.047	1.062	1.077
0.65	1.028	1.033	1.051	1.066	1.081
0.75	1.030	1.035	1.055	1.070	1.085

b. Additional load factor *B*

TSR_1, lb per hphr	Factor B	TSR_1, lb per hphr	Factor B
9	1.00	14	1.026
10	1.011	15	1.028
11	1.016	16	1.030
12	1.020	17	1.032
13	1.023	18	1.034

Rated-load steam-rate factor = $A \times B \times$ factors from Fig. 4 and 5

c. Half-load steam-rate factor *C* for noncondensing extraction turbines

TSR_1 / TSR_2	Flow ratio** 1.0	2.0	3.0	4.0	5.0
0.25	1.02	1.08	1.10	1.12	1.15
0.35	1.02	1.09	1.12	1.14	1.17
0.45	1.02	1.10	1.14	1.16	1.19
0.55	1.02	1.11	1.16	1.18	1.21
0.65	1.02	1.12	1.18	1.20	1.23
0.75	1.02	1.13	1.20	1.22	1.26

d. Half-load steam-rate factor *D* for straight noncondensing turbines

TSR_1, lb per hphr	Factor D	TSR_1, lb per hphr	Factor D
9	1.11	14	1.16
10	1.12	15	1.17
11	1.13	16	1.18
12	1.14	17	1.19
13	1.15	18	1.20

Half-load steam-rate factor = $C \times D \times$ factors from Fig. 4 and 5

*Flow ratio = (max quoted throttle flow)/(basic throttle flow at full load)

**Flow ratio = (max quoted throttle flow)/(basic throttle flow at half load)

pressure. The turbine could run at any load or extraction flow and supply part of the exhaust steam demand. Additional steam at exhaust pressure would have to be made up by throttling from the main pressure or generated (for example, by a waste-heat boiler) at the exhaust steam pressure.

If power demand exceeds that available from the turbine under a mode of operation that satisfies extraction and exhaust steam demands, additional power may have to be supplied from another energy source.

Automatic-extraction control system, Fig. 2, uses two "governors" to control speed and load in one case, and extraction pressure and flow in the other. The "3-arm" mechanism co-ordinates the operation of these two governors; "3-arm" refers to the

control-system lever shaped like an inverted T. Inlet valves connect to one of the horizontal arms, the extraction valves to the other horizontal arm and the extraction-pressure governor connects to the vertical arm. A flyball-speed-governor connection acts like a pivot or fulcrum at the junction of the three arms.

As speed tends to decrease with load increase, the speed-governor flyballs move inward raising the pivot point *P* and increasing the lift of both inlet and extraction valves. This maintains turbine speed (within normal speed-governor regulating range). Opposite actions take place with load decrease tending to increase turbine-shaft speed.

As rising demand for extraction steam lowers extraction pressure the vertical arm of the 3-arm lever moves clockwise around the pivot *P*, causing the inlet valves to open wider and extraction valves to close. This action raises both throttle and extraction flows to supply the increased extraction demand and decrease the exhaust flow. A decrease in extraction-flow demand raises the extraction pressure and has the opposite effect on the control system.

Since the two governors interconnect, coincident changes in load, speed and extraction flow are controlled satisfactorily.

Estimating method for drawing the turbine characteristic, Fig. 7, uses Fig. 3 through 6 and data in Part 9, POWER, Sept 1959. Sample problem at right shows the steps.

This method gives reasonable, though conservative, results when the turbine conditions fall within these limitations: (1) flow ratio at full load no greater than 3.0 (2) ratio of inlet to extraction pressures no less than 2.0 (3) ratio of extraction to exhaust pressures no less than 2.0 (4) TSR ratio between 0.25 and 0.75 (5) speeds from 3600 to 10,000 rpm (6) overall theoretical steam rate, TSR_1, no greater than 18 lb per hphr.

Noncondensing extraction turbines, like the condensing type, give best performance if designed without excessive flow margins. In Table, *a* and *c*, the steam-rate factors are lower at lower flow ratios. Only reasonable allowance should be made for variations in expected conditions or for future needs to avoid the penalty of poor performance.

Sample problem—Fig. 7

Steam conditions: 600 psig, 700 F, 211-F sup, 20 psig, automatic extraction at 150 psig
Rating and speed: 6000 hp and 7000 rpm Maximum extraction flow: 120,000 lb per hr

Step A—Find theoretical steam rates and extraction factor

1. TSR_1 from inlet to exhaust, Fig. 2, Part 9, *Power*, Sept 1959, p 80, lb per hphr 9.9
2. TSR_2 from inlet to extraction, Fig. 2, Part 9, *Power*, Sept 1959, p 80, lb per hphr 19.2
3. $TSR_1/TSR_2 = 9.9/19.2 =$ 0.516
4. Extraction factor from Fig. 3 ..... 0.523

Step B—Find full-load base throttle flows

1. Base efficiency for non-extracting turbine, Fig. 4, 5, 6, 7, Part 9, *Power*, Sept 1959, pp 80 to 82: $0.74 \times 1.012 \times 0.957 \times 0.993 =$ 0.712
2. Base throttle flow, lb per hr (zero extraction, full load) =

$$\frac{TSR_1 \times \text{rated load}}{\text{Base efficiency}} = \frac{9.9 \times 6000}{0.712} = 83{,}400$$

3. Base maximum throttle flow, lb per hr = max extraction flow × (A4) + (B2)
$= 120{,}000 \times 0.523 + 83{,}400 = 146{,}200$

Step C—Find full-load variable-extraction throttle flows

(1) Extraction flow	(2) Uncorrected throttle flow B2 + (A4) (C1)	(3) Flow ratio B3/C2	(4) Correction factors (Table, a) (Table, b) (Fig. 4) (Fig. 5) = (Table, a) (1.009 × 1.000 × 1.005)	(5) Corrected throttle flow C2 × C4
0	83,400	1.75	1.038 × 1.014 = 1.053	87,800
20,000	93,900	1.56	1.032 × 1.014 = 1.046	98,200
40,000	104,300	1.40	1.029 × 1.014 = 1.043	108,800
60,000	114,800	1.30	1.028 × 1.014 = 1.042	119,600
80,000	125,200	1.17	1.027 × 1.014 = 1.041	130,300
100,000	135,700	1.08	1.026 × 1.014 = 1.040	141,100
120,000	146,200	1.00	1.025 × 1.014 = 1.039	151,900

6. Plot as points *1* through *7* in Fig. 7

Step D—Find half-load variable-extraction throttle flows

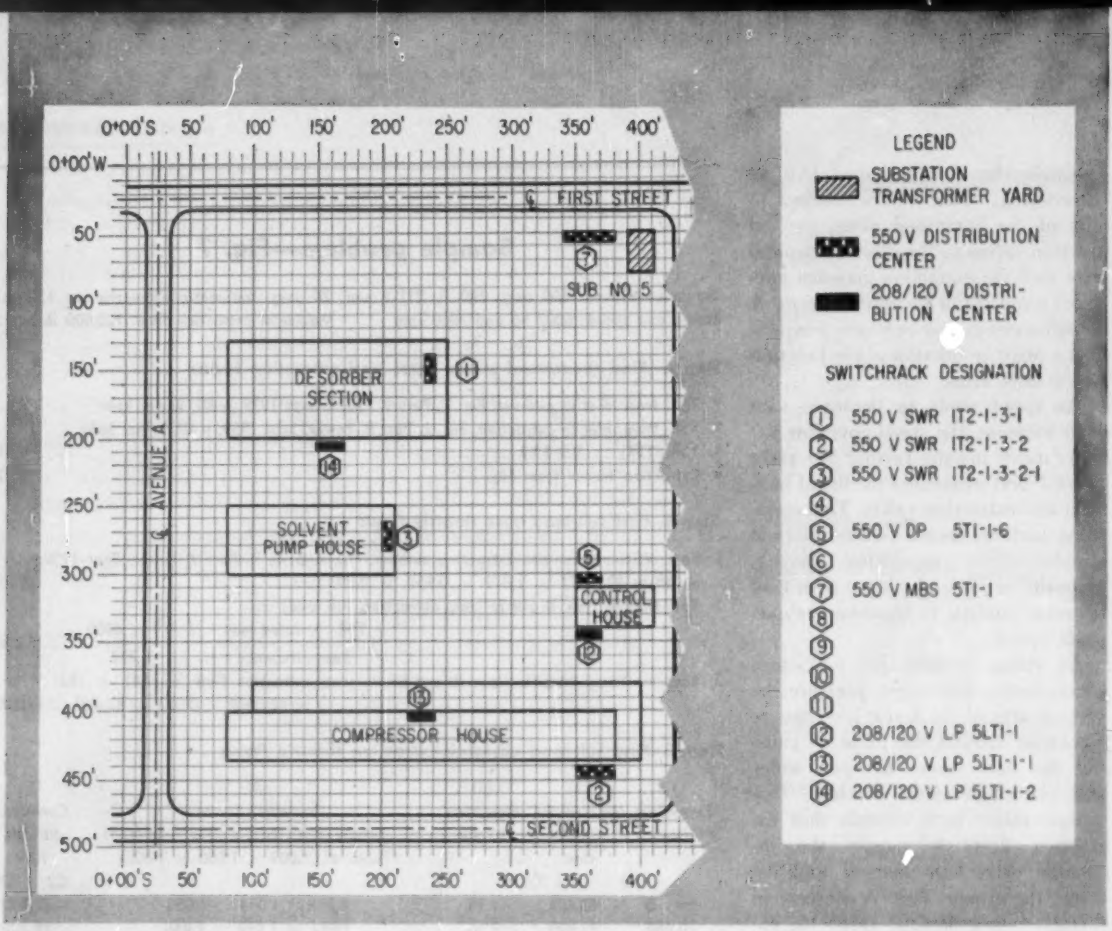
(1) Extraction flow	(2) Uncorrected throttle flow ½ (B2) + (A4) (D1)	(3) Flow ratio B3/D2	(4) Correction factors (Table, c) (Table, d) (Fig. 4) (Fig. 5) = (Table, c) (1.12 × 1.00 × 1.011)	(5) Corrected throttle flow D2 × D4
0	41,700	3.50	1.16 × 1.132 = 1.313	54,800
20,000	52,200	2.80	1.13 × 1.132 = 1.279	66,800
40,000	62,600	2.34	1.12 × 1.132 = 1.268	79,400
60,000	73,100	2.00	1.11 × 1.132 = 1.256	91,800
80,000	83,400	1.76	1.09 × 1.132 = 1.234	102,900
100,000	94,000	1.56	1.07 × 1.132 = 1.211	113,800
120,000	104,500	1.40	1.06 × 1.132 = 1.200	125,400

6. Plot as points *8* through *14* in Fig. 7
7. Draw straight lines through points at full load and half load having same extraction flows

Step E—Minimum flow to exhaust

1. Find cooling-steam flow from Fig. 6, lb per hr 5100
2. Plot points on constant-extraction-flow lines where:
Throttle flow = (extraction flow) + (cooling-steam flow)*
3. Draw the best straight line through the points between half load and max-throttle-flow lines*

*For this example the points lie on the constant-extraction-flow Willans Lines below half load. Minimum-flow-to-exhaust line was obtained by plotting the points on the extrapolated Willans Lines.



PLOT PLAN, shown for part of one area, indicates location of the distribution centers on 10-ft co-ordinate grid. Switchrack designation is keyed to plot plan by number. Substation transformer yard and distribution centers of different voltages are identified

Electrical records take on a new look

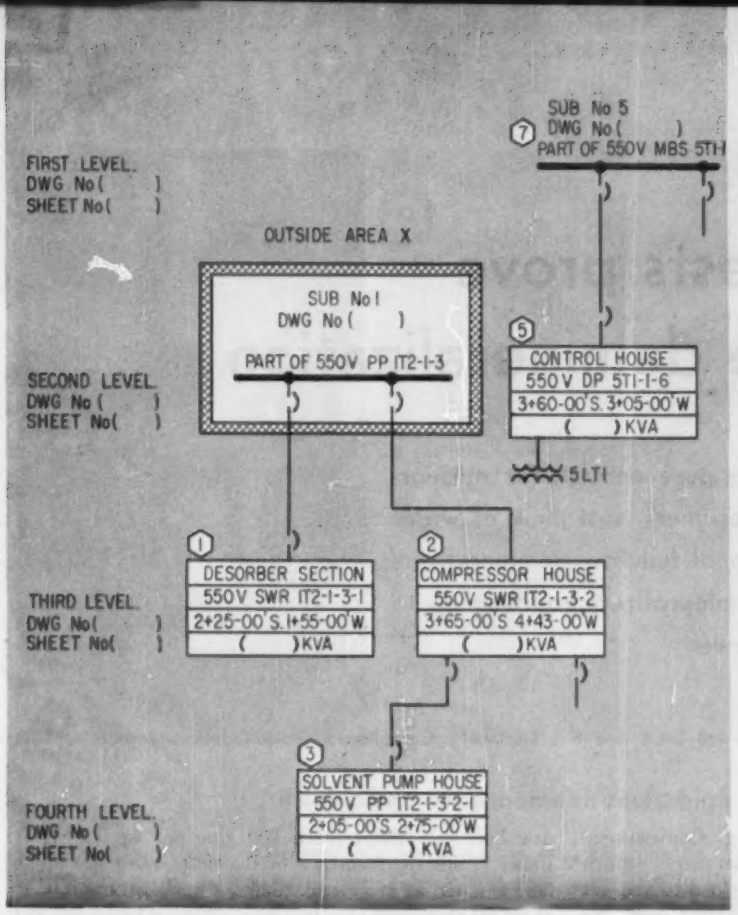
Records using four types of drawing help you keep distribution-system info up to date

By G L FRANK, Polymer Corp, Ltd
Sarnia, Ontario, Canada

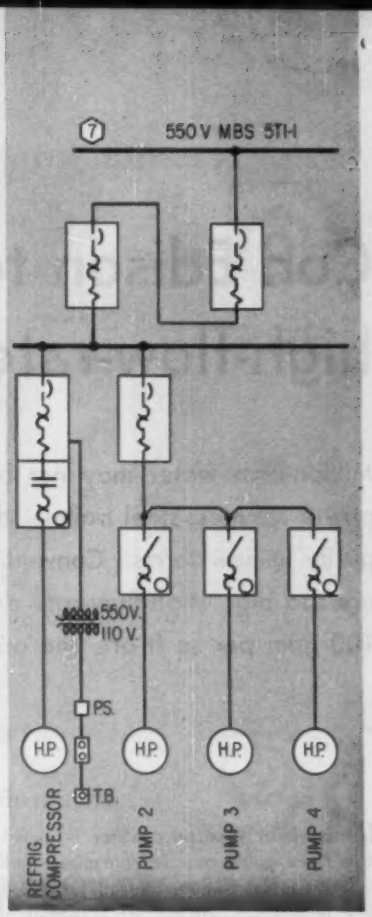
Have you noticed that electrical engineers prefer to design a completely new installation rather than tackle a revamp? They're well aware of the difficulties to be met as they attempt to get information on an existing installation. Usually they have to ferret out relevant facts from mountains of construction drawings. These drawings may be adequate from the historic point of view, but for an overall picture they just don't do the trick. Majority of existing 1-line diagrams aren't very helpful either; they weren't laid out to accommodate changes; physical locations of components aren't shown.

You can overcome these difficulties with a record system which is easy to read and easy to revise. System consists of four types of drawing: plot plan, block, 1-line and elementary diagrams. Block diagrams give overall picture of power distribution within a certain area. Any piece of apparatus can be located in the field, within a 10-ft square, from co-ordinates shown on the plot plan. These co-ordinates are tabulated on 1-line diagrams. Elementary diagrams provide key to component functions.

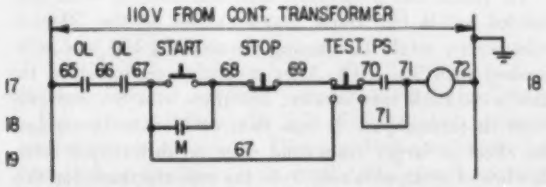
Designation of distribution centers overcomes difficulty of telling in the field where supply to a center originates. Block diagram, right, shows how power is distributed to various centers. Those at the same distance electrically from a power source (transformer) are said to be at the same *level*—level, as we use the term, refers to electrical distance rather than a stage of voltage transformation. Number of dashes in the designation expresses the level; first level is one dash, second level is two dashes, etc. Covering up the number after the last dash leaves the designation of the next distribution center "upstream," so you quickly arrive at the power source.



POWER BLOCK DIAGRAM illustrates the principle of distribution *levels*. Note that designation number of the centers changes by one digit as you proceed from level to level



ONE-LINE diagram for part of area gives electrical details on motor branch circuits



ELEMENTARY DIAGRAM indicates component circuits. Numbers at right show lines where contact is actuated by energized coil

Physical location of distribution centers is shown on the plot plan. All switchracks and other electrical equipment in the plant itself are identified by corresponding tags. Entire plant, and subsequently each plant area, is covered by a grid system. Co-ordinates are drawn on the back of the linen tracing for each area plot plan, so you can make revisions on tracing face without destroying the grid. Main outlines only of buildings and structures are shown. Main substations and distribution centers are shown and identified.

Power block diagram for an area shows all power supplies to the area and all necessary data on distribution of power within the area. Each block represents one distribution center. If a center supplies more than one area, it won't be shown as a block in either area block diagram, but will appear on the substation block diagram. This diagram doesn't show individual branch circuits except for motors (or other loads) which are supplied from a source which is outside the area.

Lighting block diagram is separate from power block diagram. Each sub should have its own block and 1-line diagram showing design in detail.

A 1-line diagram for each level shows all components of a branch circuit. Components' locations are indicated by co-ordinates from the grid system. This and other information is recorded in a table adjacent to every distribution center on the drawings. Relocation of a component in the field requires only a revision in table. By referring to the table we can easily find the elementary diagram for a particular component such as a motor control. Several drawings may be required, but all within one level have same number.

Elementary diagrams within an area may vary considerably in complexity, depending on the control method. Representation in accordance with JIC (Joint Industry Conference) electrical standards for industrial equipment will be found most satisfactory for elementary diagrams.

Electrical-record system is explained in detail in AIEE paper No. CP591154, *Electrical record drawings—reams of paper or concise up-to-date information?*

Con Edison tests prove high-flow-rate demineralization

Million-ohm water may not be pure enough for nuclear-power stainless-steel boilers; designers must think of water purity in new terms. Conventional full-flow demineralizers are too big. High-flow-rate demineralizers handling up to 100 gpm per sq ft are one answer

By I B DICK and P L SILLIMAN, Consolidated Edison Company of New York

Demand for superpure water is growing. Conventional flow rates would require enormous demineralizers—much too big to be practical. Con Edison decided to try out new techniques, aiming for a reasonably sized unit. An economical solution may mean that conventional plants, as well as nuclear, can improve water quality.

Tests at Astoria Station began in June 1957, with the pilot plant in continuous operation except during boiler outages and regeneration periods. Initially, throughput was held to 25 gpm per sq ft. Operating experience was good until 4.7-million gal of water had been processed. Then pressure drop across the equipment increased and flows decreased. Inspection showed small chips, identified as 50% magnetic iron oxide and 50% hydrated iron oxide, had largely plugged the 50-mesh inlet screen.

Screen was cleaned, and the unit went back in operation without backwash or regeneration, with the rate increased to 50 gpm per sq ft. After processing 5.3-million gal of water, increased pressure drop and decreased throughput again occurred. Pressure drop was in the bed this time, indicating the need for a backwash. Although effluent-water quality didn't demand it, the unit was also regenerated. This established that it's possible to successfully regenerate a high-flow unit in place.

Plant went back on the line and an attempt was made to obtain higher flow rates. But even with 95-psi inlet pressure, the maximum flow rate was 62 gpm per sq ft. Further backwash and remixing failed to improve this performance. Bed depth was reduced from 40 in. to 30 in. Flow rates went up to 90 gpm per sq ft, but dropped again because of buildup across the bed and the 100-psi inlet-pressure limitation.

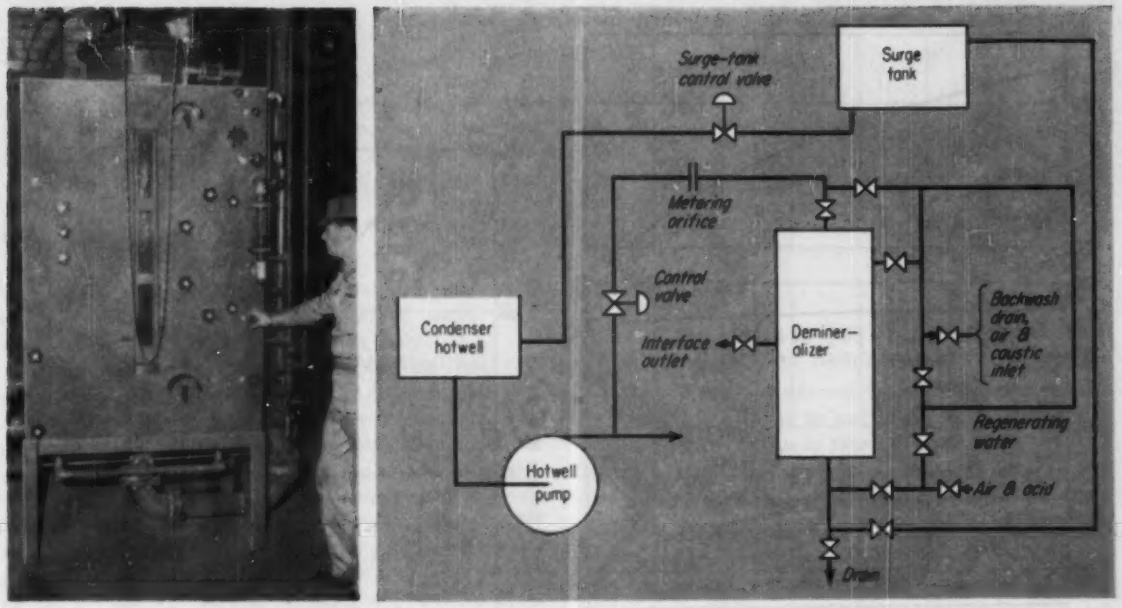
Over ten million gal of water had been processed since the start of work and inlet screen had fouled once before with suspended solids. Bed fouling was a possible cause of the poor flow rates, so bed was changed and replaced with a fresh charge of the same material. Even with the new bed, rate didn't reach 100 gpm per sq ft. Fig. 1 shows typical performance of the unit—rates got up to 80 gpm per sq ft several times but fell off rapidly to about 50 at the end of a few days. A good backwash and remixing of the bed again restored the higher rate, but only for another few days. Amount of water processed while flow rates were falling from 80 to 50 gpm per sq ft was between two and three million gal, or some 400,000 gal per cu ft of resin.

To check the possibility that bed fouling with suspended solids like those found earlier on the 50-mesh inlet screen might be causing the trouble, bed was acid-washed with 5% HCl. After a double regeneration the unit went back into service, but there was no improvement in throughput. It was then decided to investigate the effect of larger resin-bead sizes on throughput rates. Batches of resin obtained from the manufacturer for this purpose consisted of three cu ft of IR-122 and four cu ft of an anion resin known as XE-123, similar to IRA 400 except for larger bead size.

Immediately the new 43-in.-deep bed achieved the desired 100 gpm per sq ft with an overall pressure drop from above the bed to the outlet piping of about 50 psi. A set flow rate of 92 gpm per sq ft ran practically constant until 8.5-million gal was treated. Then rate was increased to 100 gpm with an overall pressure drop of about 70 psi. A rate between 90 and 100 gpm was maintained until over 12-million gal had been deionized.

From these results it is apparent that flow rates of 100 gpm per sq ft are feasible and that regeneration in place is possible. Unit was regenerated twice after long periods of service and replacement beds were regenerated in place. There was no mechanical damage to internals and no difficulty in regeneration, backwashing or remixing.

Questions of bed fouling and compacting as related to pressure drop and flow prompted installation of the Lucite tubes. One was filled with the same resin mixture as



Pilot-plant arrangement tests high flow rate

A side stream of main condensate from the hotwell pump passes through a pressure-control valve to hold inlet pressure below 100 psi, then is metered and passed through the demineralizer. Treated water goes to a surge tank, then returns to system by way of the condenser.

Pilot plant is 20 in. in diameter and 6-ft high on the straight side. Rubber-lined, it has stainless-steel internals. As originally charged it contained three cu ft of Amberlite IR-122 and four cu ft of Amberlite IRA-400. Inlet and outlet waters pass through 50-mesh stainless-steel screens. Deionizer is equipped for regeneration of resin bed in place.

As work progressed, two 2-in.-dia Lucite tubes were installed in parallel with the 20-in. unit. These tubes are 50-in. tall and not arranged for regeneration.

the deionizer and one with comparable-sized glass beads.

Data obtained from the 2-in. Lucite tubes produced several interesting results. Pressure drop was always less than that of the 20-in. unit on the same batch of resin. This may be caused by edge-leakage effect and also friction effect on the tube wall during compacting of the beds. The 2-in. column filled with glass beads showed a surprising result. The glass beads, which are clear water-white, became discolored and brownish in service —it was thought that a coating of iron oxide formed on them and was responsible for rapid increase in pressure drop. The 2-in. column was taken out of service, backwashed and the beads washed practically clean to the eye. Washings were collected, filtered, and the solids analyzed petrographically. Breakdown showed:

Magnetic iron oxide	20-30%
Ferric oxide	30-40%
Copper oxide	20-30%
Organic material	5-15%
Total silicates	1-10%

Total weight of solids was 7.7 grams. When returned to service the Lucite column with glass beads was restored essentially to initial performance.

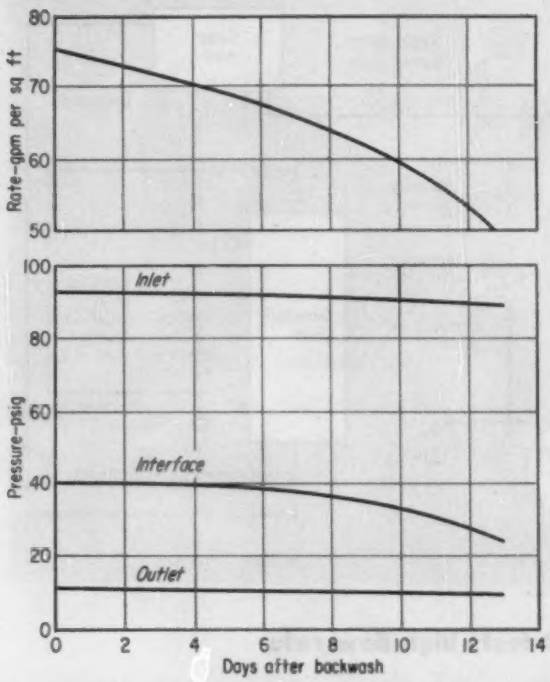
Fig. 3 shows the relationship between flow rate in gpm per sq ft of bed area and pressure drop per ft of bed depth. Improvement in pressure drop of the 20-in. unit and 2-in. tubes with large beads is pronounced. Also of interest is the lesser pressure drop shown by the 2-in. column tests.

Relationship between resin-bead size and pressure drop is further illustrated in Fig. 2, which plots average bead size against pressure drop for the large and standard beads in both 2-in. and 20-in. columns. Here again it is evident that lower pressure drops result with larger beads and with smaller-diameter tubes.

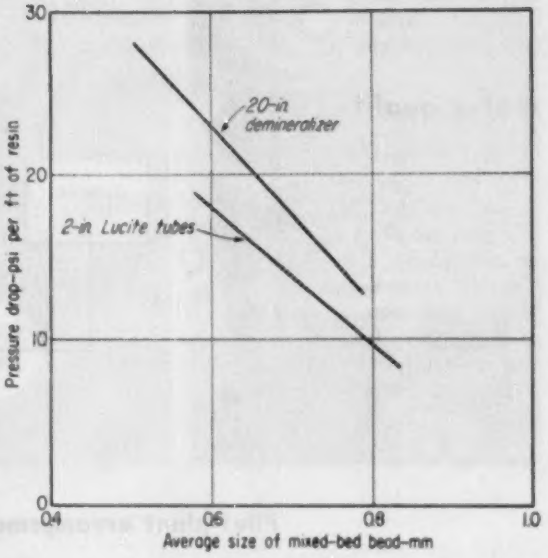
Resin breakage and loss

Backwash water was screened before being wasted and the collected resin was weighed, screened and examined under the microscope for bead condition. The 3% loss shown agreed with a physical measurement of the bed on the sight glass. Data on large-bead sizes are scant because of length of runs, but indication is that resin losses will be very small.

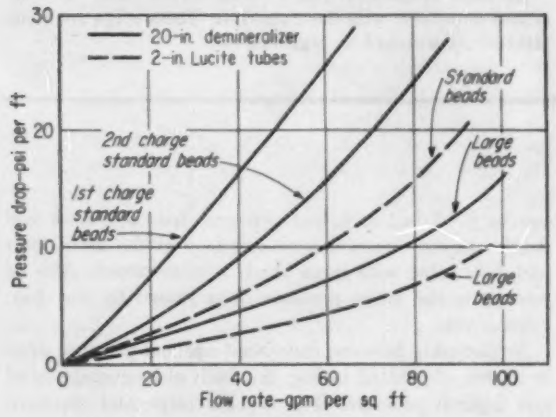
As the run progressed, backwashed resin fines collected showed no particular change until about 11-million gal of condensate had been treated. At this point



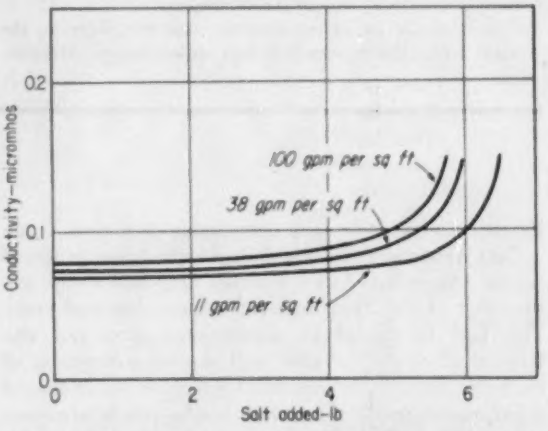
1 Throughput rate and interface pressure drop off during run after backwash and remix. Inlet, outlet pressures are constant



2 Pressure drop per ft of resin in 20-in. pilot plant and 2-in. tubes reduces about 50% for 60% increase in resin-bead size



3 Pressure drops increase with flow rates for 20-in. pilot plant and 2-in. tubes. Using large beads reduces pressure drops



4 Flow-rate changes don't affect bed's ability to maintain low conductivity with loading equivalent to condenser leak

the screen analysis showed finer particles. Microscopic examination of the resin fines after 13-million gal showed an increase in number of broken beads. Finer beads and large percentage of broken beads were again found after a total of 17-million gal had been demineralized.

Bed compacting

Compacting or compression of the small-bead bed was measured after several cycles of about 3,000,000 gal of water processed. Bed compressed between 3 and 3½ in. during the first four cycles, then almost 4 in. on the fifth cycle and 4½ in. on the sixth. A connection may exist between this compression and the increase in fines on backwashing during the latter cycles.

Large-bead bed compressed gradually by 4 in. after 12-million gal was treated, but the second standard resin charge passed that degree during the fifth cycle.

Ultimate compression during one cycle does not occur all at once—it is gradual and quite uniform during the

cycle. A relationship appears to exist between increase in bed compression and decrease in throughput rate. Data on the large-bead resin indicate a similar relationship except that change in compression rate is much less.

Water quality

The high-flow-rate pilot plant was equipped with a conductivity recorder operating on inlet and outlet water samples; pH was manually determined daily.

At first samples were tested frequently for iron, copper and sodium. However the variations were small, so a weekly test schedule was considered adequate. Occasional tests were also made for total silica. Soluble or reactive silica tests made daily have always been zero.

In general, inlet-water quality was very good and outlet-water quality was excellent, averaging close to 20-million ohms for the entire 18-million gal treated on the second resin refill. In spite of this, with an influent pH of 7.6, effluent pH remains at about 6.2. Inlet sodium values of 0.005 to 0.009 ppm went down to 0.002 to 0.003 ppm as determined by flame photometer. Iron influent of 0.029 ppm reduced to 0.006 and copper of 0.047 to 0.014 ppm. Total silica which in all cases is nonreactive reduced somewhat, probably by mechanical filtration or occlusion. Chloride values were too low for chemical tests—below 0.01 ppm.

Test data for the large-bead resins show a slight increase in effluent conductivity compared to the previous charges. This follows since the flow rate was increased by 40%. There is very little reduction in copper and iron through the bed, which may mean less filtering action at the higher flow rates.

The 2-in. tube containing standard resin gave results agreeing very closely with the pilot plant. Tube containing glass beads had no effect on conductivity but did reduce iron to zero and showed some reduction in copper. This confirms the analysis of glass-bead washings.

Frequent sampling and analysis of water during one full throughput pressure-drop cycle on the second resin fill disclosed no trend over the ten days of the cycle.

On occasion, the main condenser developed leaks which showed up in conductivity measurements of the condensate. A true measure of the leakage could not be made because 7 to 8% of the condensate is continuously deionized and recirculated; nevertheless effluent conductivity remained at 0.06 to 0.08 micromhos during the leakage period. As a further check, tests were run using a salt loading of 17 ppm. Fig. 4 shows results of these tests at various flow rates. Resin capacity remained virtually unchanged for all flow rates from conventional to 100 gpm per sq ft, showing that nominal condenser-leakage conditions can be handled at high rates of throughput. However, a high-flow-rate demineralizer to take full flow from the condenser must not be regarded as a means of holding a badly leaking condenser on the line indefinitely. It is a means of keeping a condenser with nominal leakage on the line until the earliest possible outage time, or a more seriously leaking condenser on the line long enough to effect an orderly shutdown.

Conclusions

(1) Flow rates of 100 gpm per sq ft on full-flow condensate demineralizers are feasible

(2) Water of extremely high quality results and this quality is not affected by incidental condenser leaks in normal operation

(3) High-flow mixed-bed demineralizers can be successfully regenerated in place

(4) Capacity of resins for this operation is more than ample

(5) At the end of a 15-million-gal throughput, a resin-bead loss of about 3% occurs

Here's what others say

We believe that the first "polishing" demineralizer was installed at our Elrama Power Station in 1952. While it originally handled only 5% of condensate flow, this has now been increased by 60% through high-flow-rate techniques. Using available experience, it is now economically feasible to polish up to 100% of condensate flow.

In nuclear work, corrosion products become radioactive and create a maintenance problem. High-flow-rate demineralization will do a major job in removing these small but highly objectionable amounts of radioactive fission and corrosion products.

Dr S F Whirl, Duquesne Light Company

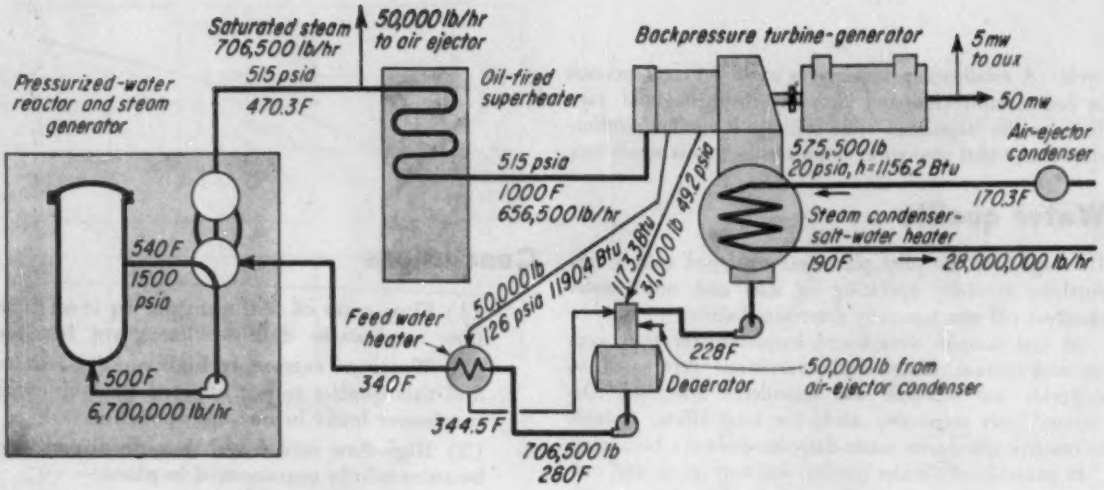
That a large portion of the Fe and Cu is present as suspended solids is most significant. This suggests that filtration (not ion exchange) may become the most important aspect of condensate polishing.

Continuous demineralization of all condensate permits use of O_2-removal resins ahead of mixed bed. Tests show dissolved O_2 can be reduced to 0.002 ppm. This offers simple solution to startup O_2 problems.

J K Rice, Cyrus Wm Rice Company

Tests at our Burlington Generating Station since early 1958 show feasibility of high-flow-rate demineralization. According to our engineers, 50 gpm per sq ft is believed practical, minimizing bead breakage and reduction in exchange capacity.

Public Service Electric & Gas Company



POWER AND DISTILLATION PLANT uses pressurized-water reactor fueled with natural-uranium oxide and using heavy-water moderator and coolant. Reactor generates saturated steam, oil-fired superheater raises it to 1000 F for 55-mw turbine exhaust-

Fresh water from the sea distilled by atomic power will soon be put to the test. Here's summary of a study made for The Martin Company back in 1957 to explore . . .

Sea-water distillation by nuclear power

By HENRY E BETHON, Consulting Engineer

The projected process-heat reactor to work with a sea-water distillation plant at Point Loma in San Diego, Calif., reminds us of a study we made in April 1957. This covered the economics of four different reactor power-plant distillation-plant arrangements. Diagram, above, gives data on the most economic of the four.

All schemes studied used a pressurized-water reactor with a heavy-water moderator-coolant and fueled with natural-uranium dioxide. To allocate the cost of sea-water distillation all four schemes were compared to a base plant using the same reactor to supply saturated 515-psia steam to a 55-mw turbine exhausting at 2 in. Hg abs, Table 3. No water was distilled in this plan, but allocated distillation costs for the four schemes were figured as the difference between total costs of combined electric-distilled-water output and the cost of generating electricity only in the base scheme.

Table 1 gives the primary data and costs of the plant in the diagram. Table 2 shows the allocated unit costs for the fresh water produced by the combination plant. The base power plant has a capital cost of $20.5 million while the combined plant above costs $29.3 million, so the allocated capital charge for the sea-water distillation is 29.3 – 20.5 = $8.8 million.

Basing calculations on 50-mw net output, 6-million-gpd fresh water and 80% plant factor the water unit costs come to the figures given in Table 2. The corresponding unit cost for electrical energy output is:

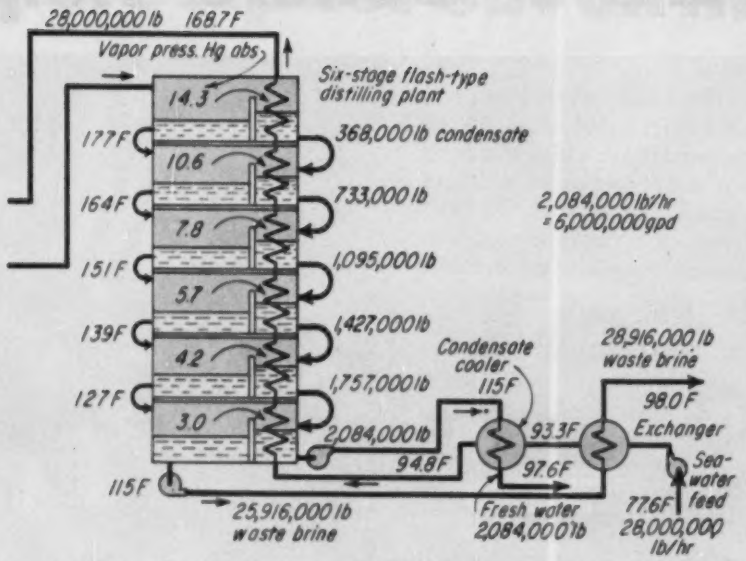
5% capital charges (20-yr life)	11.5 mills per kwhr
10% capital charges (10-yr life)	14.4 mills per kwhr
14% capital charges (7-yr life)	16.8 mills per kwhr

Costs are based on burning 5¢-per-gal Bunker C oil in the superheater.

This analysis assumes the Atomic Energy Commission will bear the research and development charges for designing and developing the reactor. It also assumes the Department of Interior will bear similar charges for developing the multistage distillation plant.

Comparison. The energy unit costs compare with a U.S. average of about 8 mills per kwhr. This plant could possibly compete with conventionally fueled plants in high-cost areas of the country.

The water costs compare with averages of about 13¢ per 1000 gal for irrigation water and 35¢ per 1000 gal



ing at 20 psia. Turbine exhaust steam supplies low-temperature energy for running 6-stage sea-water distilling plant that produces 2.1 million lb of fresh water per hour

Table 1—Power-water-plant data

1. Electrical capacity, gross kw	55,000
2. Electrical capacity, net	50,000
3. Steam generated, lb per hr	706,500
4. Feedwater temperature, F	340
5. Steam to turbine, lb per hr	656,500
6. Turbine throttle temperature, F	1000
7. Turbine backpressure, psia	19.7
8. Turbine throttle pressure, psia	515
9. Turbine exhaust flow, lb per hr	575,500
10. Turbine exhaust temperature, F	228
11. Steam to air ejector, lb per hr	50,000
12. Superheater oil supply, lb per hr	11,230
13. Superheater thermal efficiency, %	90
14. Fuel-oil cost at 5¢ per gal, per hr	$74
15. Fuel-oil cost at 8¢ per gal, per hr	$118
16. Fresh-water output, gpd	6,000,000
17. Fresh-water output, gph	250,000
18. Heat output of reactor, 10^6 Btu/hr	630
19. Cost of reactor plant	$11,800,000
20. Cost of turb-gen plant	$5,000,000
21. Cost of oil-fired superhtr	$2,000,000
22. Cost of distilling plant	$8,000,000
23. Cost of auxiliary equipment	$2,500,000
24. Total cost of plant	$29,300,000

Table 2—Total distilled-water costs at 80% plant factor

Capital-charge rate, %	5		10		14	
Fuel oil, ¢ per gal	5	8	5	8	5	8
Costs, ¢ per 1000 gal of fresh water:						
Capital charges	25.0	25.0	50.0	50.0	70.0	70.0
Fuel	27.5	46.0	27.5	46.0	27.5	46.0
Operation	4.0	4.0	4.0	4.0	4.0	4.0
Maintenance	2.0	2.0	2.0	2.0	2.0	2.0
Totals, ¢ per 1000 gal	58.5	77.0	83.5	102.0	103.5	122.0

Table 3—Estimated investment for 50-mwe natural-uranium-dioxide heavy-water reactor

	Investment, $1000	Unit cost, $ per net kw
PRIMARY SYSTEM		
1. Reactor less fuel bundles[a]	2670	53.4
2. Primary loops, 2	1706	34.1
3. Auxiliary and pressure systems	1410	28.2
4. Instrumentation, excl reactor's	550	11.0
5. Fuel handling & decontamination	400	8.0
6. Buildings, structures, etc	2883	57.7
7. Subtotal	9619	192.4
8. Contingencies at 10%	962	19.2
9. Total primary system	10,581	211.6
SECONDARY SYSTEM		
10. Turbine-generator & auxiliaries	4500	90.0
11. Buildings, structures, etc	2000	40.0
12. Total secondary system	6500	130.0
TOTAL DIRECT COSTS	17,081	341.6
FUEL CORE		
1. Element & bundle fabrication incl Alnic cladding[b]	600	12.0
2. Fuel—19 tons UO_2	691	13.8
3. Subtotal	1291	25.8
4. Contingencies at 10%	129	2.6
5. Total fuel cost	1420	28.4

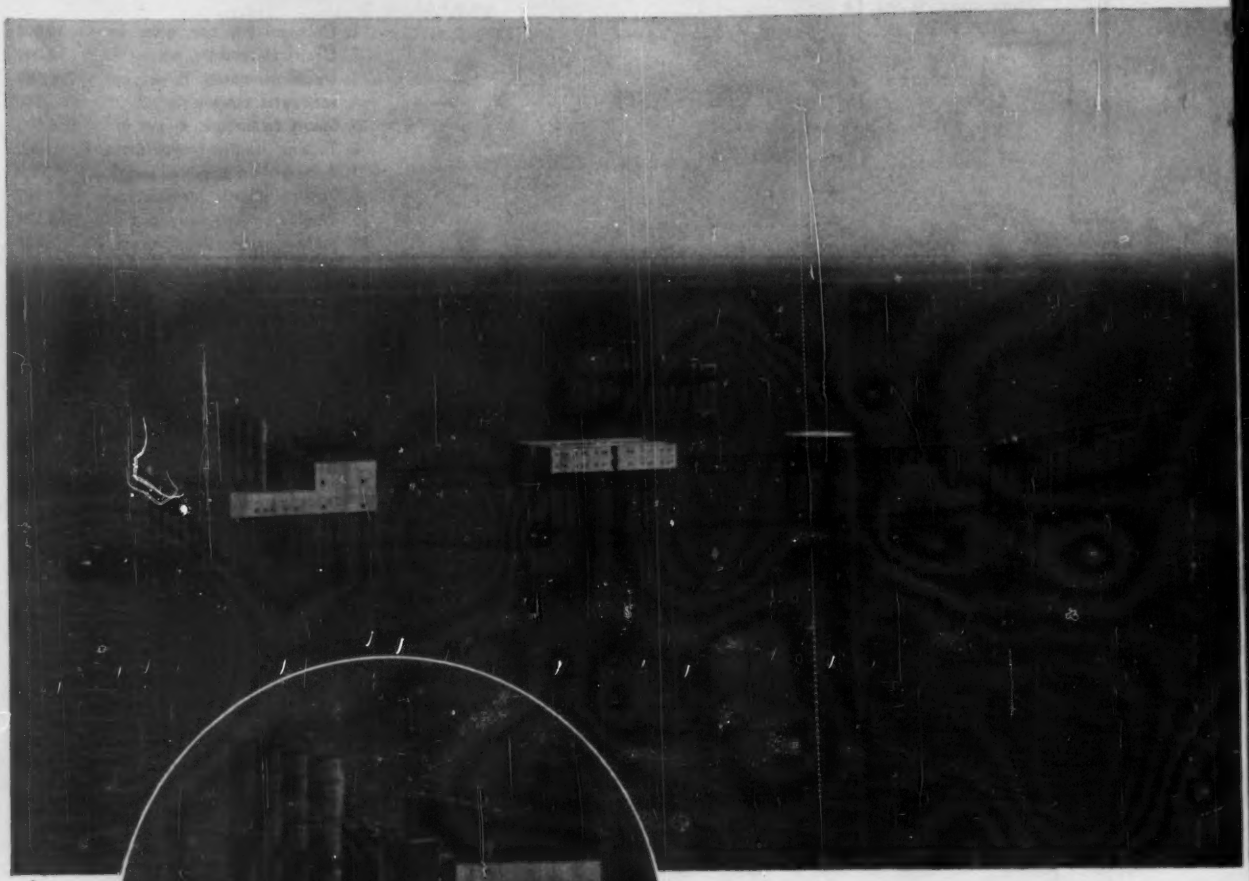
a—Fuel cost given in bottom section of table
b—Zirconium use adds $1.5 million to total costs

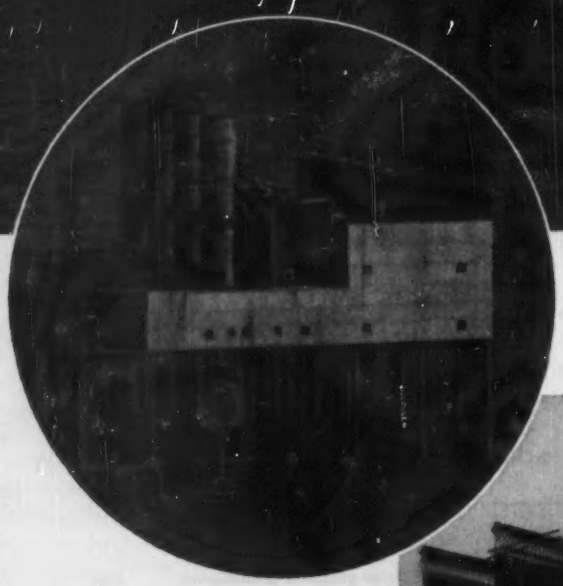
for municipal supply. Some industries pay as much as $2 per 1000 gal of water in special situations.

The Government prefers to work on processes that offer promise of producing fresh water for $1.50 per 1000 gal or less. The combination plant falls well within this limit.

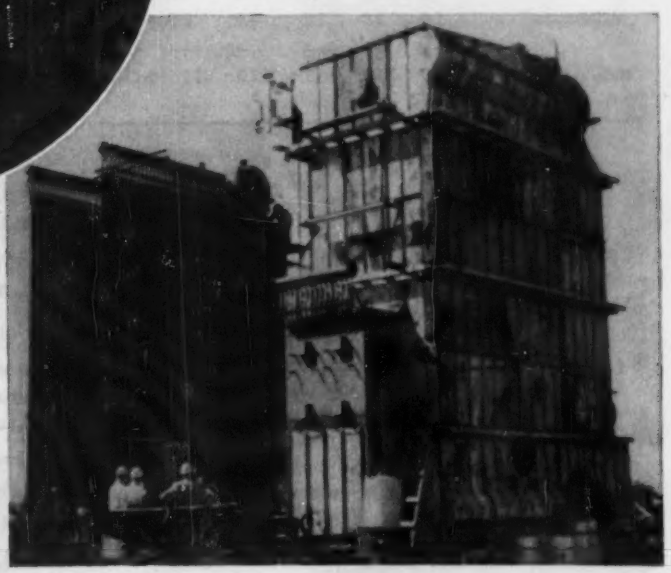
Objectives. Many areas could use combined power-distilling plants of smaller capacities than the ones studied. Small packaged type power-water generating plants having capacity of two mw and 200,000 gpd would find an export market in the Middle and Far East. These could make power and water for distribution to a community from a single source at an economy competitive with conventionally fueled methods.

FOUR RILEY Boilers Help





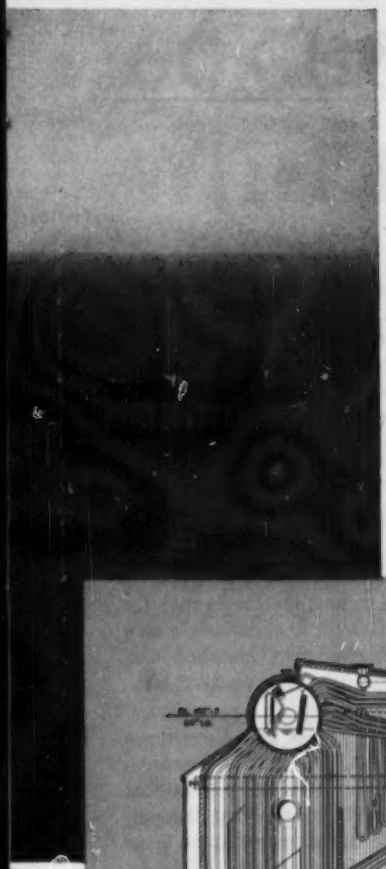
Four Riley Type RX Pressurized Boilers. Capacity 90,000 lb/hr — 625 psig — 600 F. Fuel — Natural Gas, Turbine Exhaust Gas.



Low excess air, refractory elimination, uniform heat distribution and absorption are the desirable characteristics of the Riley Intertube Gas Burners.
Prefabricated assembly of boilers assists in delivery and speeds construction.

A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

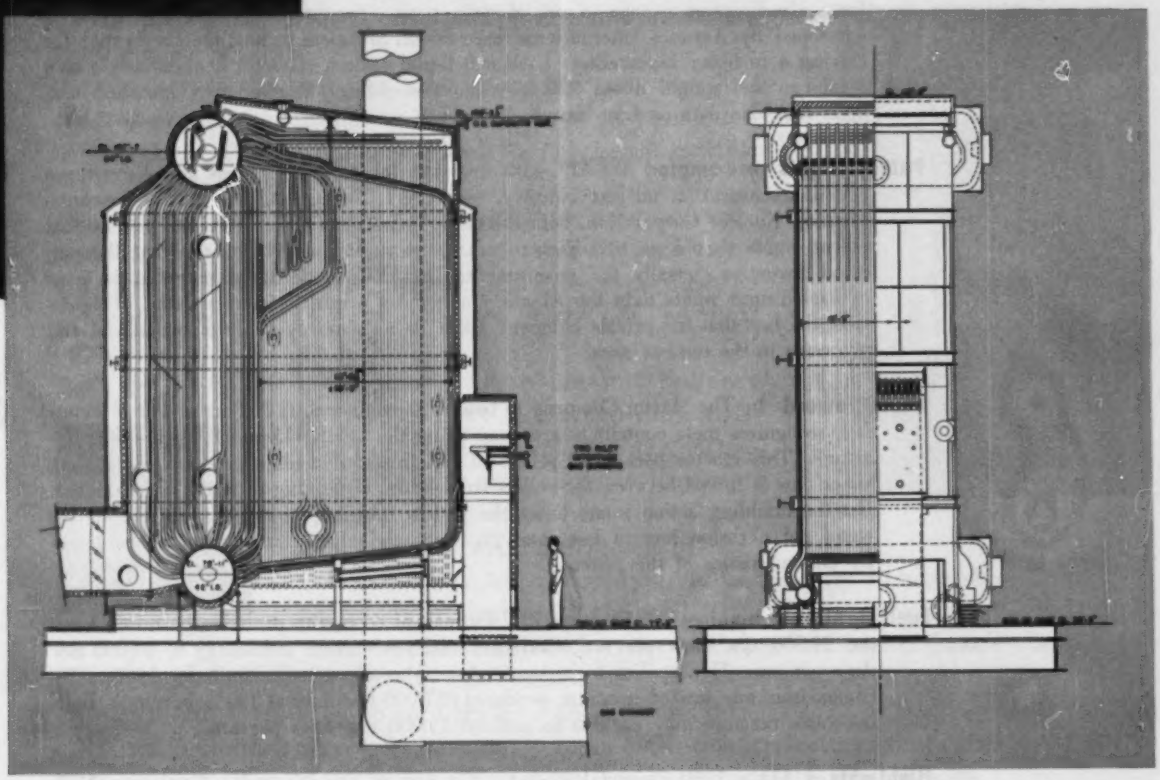
Mine Sulphur Seven Miles At Sea



Freeport Sulphur Company has installed four 90,000 lb/hr Riley type RX Pressurized Boilers on the World's largest man-made structural steel island in 50 feet of water seven miles out in the Gulf of Mexico (off Grand Isle.) These boilers will supply steam for electrical generation and steam for the Frasch Process of mining ancient brimstone deep below the Gulf's floor from a platform 75 feet above the water line.

Boiler settings must be strong enough to withstand hurricane force winds, vibration free, and light in weight.

Here is another example of how Riley designs and builds boilers to meet unusual engineering specifications. Let your Riley sales representative provide you with up-to-date information about Riley boilers and fuel burning products.



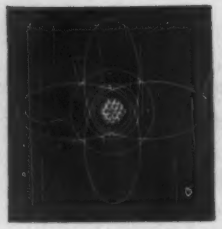
You'll Find A Riley Representative In Each Of These Principle Cities:

Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Boston.

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT

RILEY STOKER CORPORATION, WORCESTER, MASS.



Nuclear notes

By B G A SKROTZKI, Associate Editor

Uranium-ore supply shows encouraging growth according to AEC reports. Reserves in January 1948 were 1 million tons; this grew to 88.9 million tons in July 1959. In fiscal year 1948 ore produced equaled 54,000 tons with 0.31% U_3O_8 concentration. In 1959 we will produce about 6.1 million tons with 0.26% concentration. Concentrate purchases by AEC in 1948 were $1.7 million for an average cost of $7.14 per lb; in 1959 this grew to $280.5 million at an average cost of $9.25 per lb. Highest cost per lb was in 1955 at $12.51. In 1948 the mills employed 650 people; this grew to 3185 in 1959.

SNAP Experimental Reactor (Systems for Nuclear Auxiliary Power) has been developed for space satellites. SNAP I and III developed by The Martin Company use heat from a radioactive isotope to run electric-power-conversion equipment. SNAP II developed by Atomics International uses fission processes to heat mercury vapor for driving a turbine; intermediate coolant is liquid sodium. Reactor is about as big as a 5-gal can and weighs about 220 lb without shielding. Reactor uses enriched uranium fuel. No data on heat rating.

Patent rights pre-empted by AEC kills incentive for atomic progress and discourages added investment in nuclear industry, says Lee L Davenport, president of Sylvania-Corning Nuclear Corporation, before Atomic Industrial Forum. Idea seems to be that patent rights should go to whoever contributes most money to conceiving the patented invention, usually the government. The AEC now demands more in the area of background rights than the Atomic Energy Act originally contemplated. This despite the fact that the private company spent its own money to develop material and processes in the nuclear area.

$1000 award by The Martin Company to two of its engineers, H N Barr and D H Peterson, recognizes their contribution to improving the LFBR (Liquid Fluidized Bed Reactor). This reactor uses small pellets of fuel in water inside a cylinder. To fission, water flow is forced between the pellets from below, separating them the right amount. But the tumbling action wears away the pellets. Adding powdered graphite to the water cut abrasion loss to less than 20% of original and may improve heat-transfer characteristics of the system.

Fuel burnup for uranium dioxide, says F K Pittman of AEC, can probably be raised from the 27,500 mw days per ton maximum which is current technology to 40,000 mw days per ton. This applies to pressurized-water reactors to be built by 1965. (By comparison one ton of uranium produces 857,000 mw days at 100% burnup.) Boiling-water reactors may be able to achieve 19,000 mw days per ton.

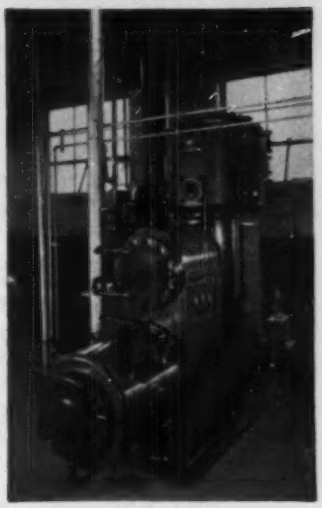
Highlights of AEC's 1959 Financial Report: Net cost of operations for fiscal year 1959 was $2.5 billion—9% higher than in 1958. Reactor development, high-energy physics, controlled thermonuclear energy, peaceful applications of nuclear explosives, isotope development, life-science research, weapons development and fabrication, and procurement of uranium were expanding activities throughout the year. During fiscal 1959 reactor development cost $356 million, including $105 million spent for specific civilian reactors for stationary power; this program was 16% higher than 1958. Physical research programs cost $112 million which includes thermonuclear research at $28 million and high-energy physics at $28 million. Weapons development and fabrication cost $492 million during fiscal 1959.

60,000 HOURS . . . WITH NO BEARING WEAR

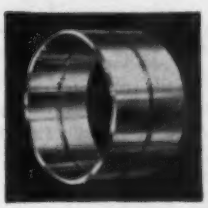
in this IR compressor

Sound unbelievable? Here's how it happened.

This 125-hp Ingersoll-Rand XLE compressor was installed in 1950 at the Standard Products Company in Cleveland. By the summer of 1958 the unit had totalled approximately 60,000 hours of operation, averaging 20 hours a day, six days per week. It was shut down for complete annual inspection as part of the plant preventive maintenance program.



Long before the unit was shut down the customer had ordered new main bearings to keep in reserve stock in event of emergency. It was decided to install the new bearings while the compressor was torn down for inspection. When the old bearings were removed they were checked for wear and were found to be within the original one-thousandth-inch tolerance *for new bearings*. This means that there was *no measurable wear*, even after the equivalent of 20 years of "normal" operation!



Of course, these are not ordinary bearings. They are *aluminum full-floating* bearings, one of the extra-value features found only in Ingersoll-Rand compressors. These heavy-duty bearings roll with the punch of each compressor stroke, distributing the load evenly all around the inside and outside of the shell. Their special aluminum alloy has better load-carrying capacity and higher heat conductivity than other bearing materials. And they *never need adjustment*, so the running gear may be kept sealed from dust and dirt.

Ingersoll-Rand compressors have many more extra-quality features that can save you money in your plant. Call your I-R representative—he has the solution for any compression problem.

The World's Most Comprehensive Compressor Experience . . . **Ingersoll-Rand**

I-982 11 Broadway, New York 4, N. Y.

For more facts circle 243 on Reader Service card, p 101

Reserved for your comment

BOB BELLAS, Associate Editor

Someday we've got to get organized

I am heartily in accord with the idea of endeavoring to establish a uniform examination for the various grades of stationary operating engineers and firemen in those states that have engineer and fireman license laws (*George Edwards*, Dec 1959, p 194).

Further, it would seem to me that the examinations must be written to achieve uniformity. At the present time some states use written examinations, some written and oral, and at least one state gives oral examinations only.

Stationary steam plants, wherever located, function on the same principle and the same degrees of skill and attention are required in their operation. It follows that the examinations used to determine operators' fitness should be of similar standards regardless of where the examinations are held.

C O MYERS, *Executive Director*
The National Board of Boiler and Pressure Vessel Inspectors
Columbus, Ohio

. . . I think George Edwards' reasons for standardization of operating engineers' licenses are in line with how a great many people feel about it. As he implied, it's an old argument; everyone has ideas about it but no one does anything to help.

Before anything could be accomplished in this direction, some national body would have to become interested enough to institute positive action. Steve Elonka offered to carry the ball and encouraged legislative action in his special report a few years back. (*License Requirements*, POWER, Feb 1950). However, I'm not so sure that legislation is the proper way to handle it. At least not in getting the thing off the ground.

Usually states having license requirements leave type of exam to discretion of the person in charge of the particular department.

A possibility might be to start with the Chief Boiler Inspector for each state government. Each is a member of the National Board of Boiler and Pressure Vessel Inspectors. One or several of the Chief Inspectors could draw up a model examination. They would ask permission of the National Board's executive committee to present this model examination to the National Board membership at the next general meeting. A committee could be formed; each member of the National Board should be appointed to this committee in turn. National Board membership could discuss committee's recommendations with their individual state governments to decide whether or not they are acceptable.

I believe this course would produce desired results. Each National Board member would feel that he had an active part in the standardization procedure, rather than feeling that something was being forced upon him. Once the committee began to function smoothly, I think individual states would handle licenses on a reciprocal basis as they now do with Boiler Inspector commissions.

J J BARRANGER, *Baltimore, Md.*

. . . The subject is, without doubt, a very controversial one, yet this seems to be an opportune time to bring it up. There is no question that with advances in design of power-plant equipment, many examination questions have become obsolete. One must remember, however, that some state and municipal authorities responsible for conducting the examinations are jealous of their prerogatives and will be opposed to any infringement of their autonomy. It may take considerable time to get these authorities to agree to any set of standards, but if agreement can be reached on standards by several adjoining authorities, it's generally true that the remainder can be brought into the fold.

May I suggest that the NAPE as well as plant management join hands in leading the forces for the setting up of examination standards.

JOHN TODD, *New York, N. Y.*

EDITOR'S NOTE: *We've gotten other comments, unfortunately too late to make this issue, on George Edwards' proposal to standardize operating-engineer examinations. Thinking seems to be overwhelmingly in favor of the idea. We'll publish more letters next month, and the next if you want to be heard.*

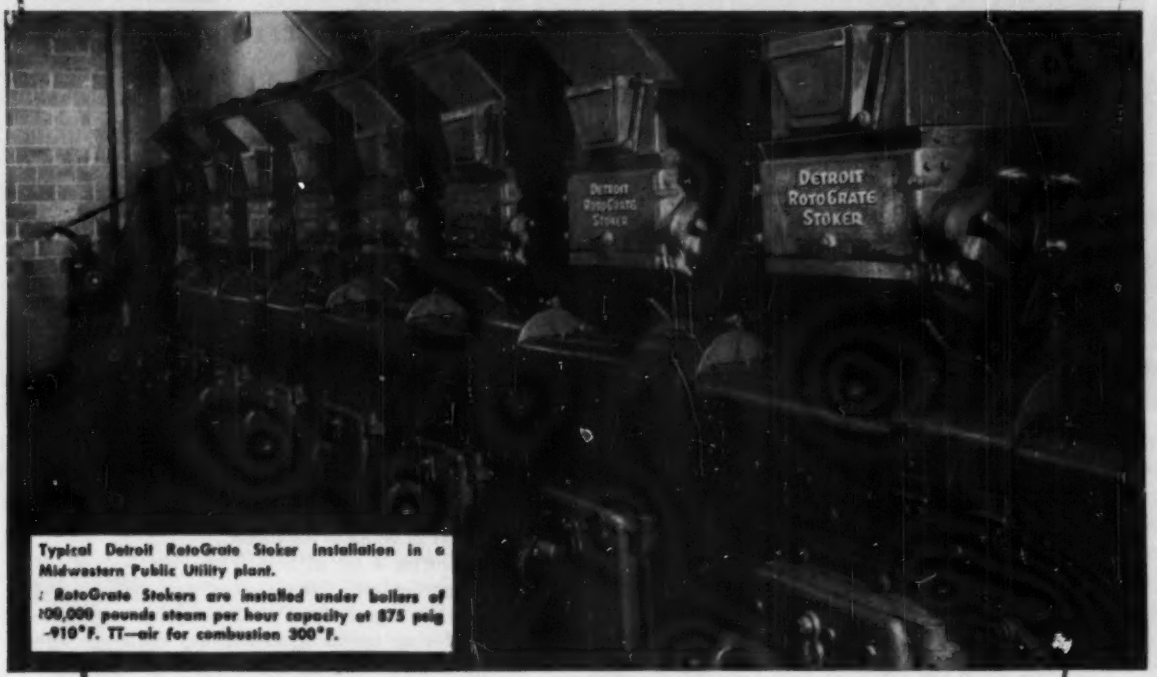
Come back, Little Gypsy

I was very much interested in your article about the controls being designed for the Little Gypsy plant of Louisiana Power and Light Co (*Control breakthrough at Little Gypsy*, May 1959, p 64). It claims this "will be the first fully automated electrical-power-generating station," and states the plant is scheduled to be finished in 1960.

After reading your article, I thought you might be interested in the enclosed piece entitled *Nantucket utility goes automatic*. This control system is not as sophisticated as the Little Gypsy plant. However, the Nantucket Gas & Electric plant is an "electrical-power-generating station." It started on automatic operation in January 1959, was accepted by the customer in June 1959 and is completely

WHAT OUR CUSTOMERS *"Say"* ABOUT

Detroit ROTOGRATE STOKER Performance



Typical Detroit RotoGrate Stoker installation in a Midwestern Public Utility plant.

: RotoGrate Stokers are installed under boilers of 200,000 pounds steam per hour capacity at 875 psig -910°F. TT—air for combustion 300°F.

Our field engineers get around—visit plants in all parts of the country and their reports tell us that users say their RotoGrate Stokers—

DO OPERATE with lower excess air—22% is common—less in many cases . . . Reason—the floating, self-adjusting air seals—a RotoGrate exclusive.

DO HANDLE load fluctuations easily . . . Sudden load increases picked up without loss of pressure—the thin fast burning fuel bed permits dropping load surges just as rapidly.

DO BURN all grades of bituminous and lignite coals, and many kinds of waste and refuse fuels . . . Ability to burn the less costly fuels available in any area is a potent factor in economical operation.

DO MAINTAIN uniform high efficiency in everyday operation. RotoGrate doesn't need special test conditions to show superior results.

DO SET a high standard of availability . . . A survey of users shows exceptional availability records in all kinds of plants.

DO OUTPERFORM other fuel burning equipment . . . Where it is possible to compare with other fuel burning equipment under similar conditions, operators almost without exception express preference for the RotoGrate.

DO SAVE . . . Low cost fuels—high efficiency—very little parasite power for operation—broad load ranges with uniform steam pressure—low maintenance—and not least important reduced production losses from outage . . . all contribute to savings that pay a handsome return on the investment.

DO YOU feel you can afford not to avail yourself of these advantages and economies for YOUR boiler plant? Why not write for bulletin 40 which describes the RotoGrate for boilers up to 400,000 pounds per hour capacity? Then let us recommend the correct stoker for your needs, without obligation of course.

Write **DETROIT STOKER COMPANY**

Main Office and Works, Monroe, Michigan

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For more facts circle 244 on Reader Service card, p 101

automatic. It puts units on and off the line without an operator and without pushbuttons.

We spent several years designing the system. We installed it, it works, and I can't resist doing some crowing on behalf of the engineers in our Electronic and Controls Division.

J P RENTZ, *Manager*
Application Engineering
The Cooper-Bessemer Corp
Mt Vernon, Ohio

EDITOR'S NOTE: *Reader Rentz is right. Nantucket Gas & Electric's plant is an "electrical-power-generating station" and is fully automatic.*

We should have described Little Gypsy as the first fully automatic "steam-electric" power-generating station. This would have distributed honors more precisely in line with the facts.

Pro and con—on the rocks

Congratulations for the fine article on preventive maintenance. It's the best and most complete I have read (*TD* Report, Nov 1959, p 191). I'd like to put in a plug for Marmaduke and his success in lowering the diesel on blocks of ice. I don't question this at all. The Egyptians floated tons of rocks along the Nile; used levers, rollers, mud and clay ramps to build the Pyramids.

In 1922, at a creamery in York, Pa., we lowered a 1-ton square tank inside a 5-ft walled enclosure. Problem was to get men and gear out of this enclosure as the tank started down. So we did exactly what Marmy did with the diesel. The tank settled in place nice and snug as we knew it would.

J H BOYER, *Frederick, Md.*

. . . I planned to do this with a set of large salt tanks when I was Chief Engineer for Worcester Salt Co back in 1930. But it was so difficult to get the ice and so cold in northern New York at the time the job was ready I had to abandon the idea. But application of this idea to a 50-ton piece of expensive machinery is what stretches one's credulity. I have engineered many a 750-hp diesel, but never with an ice jack.

W P KEARNEY, *Staff Engineer*
American Hydrotherm Corp
Long Island City, N. Y.

. . . Current hassle over Marmy's ice-jack principle has us old-timers laughing at these boys of little faith who must be shown to be convinced that some rather drastic methods are completely practical. Unquestionably the ice jack would function effectively if precautions were taken to melt the mass uniformly as Marmy advocated.

Back further than I care to remember, we were faced with a dilly. On my first stateside job after a Canadian-Alaskan tour of duty, we attempted to pump out a cofferdam prior to pouring a bridge abutment. Our 4-stage 1000-gpm centrifugal pump couldn't keep water out because of fissures in the bottom ledge. We had never heard of a tremie tube for placing dry-concrete aggregate, but we assumed the principle would work. A rude tremie was fashioned of plank, the pier was built and still stands on State Highway 77 in northern Wisconsin.

P C ZIEMKE, *Clinton, Tenn.*

The three faces of Eve

My subscription is due to expire shortly and I'm not sure I'm going to renew it. Here's why: Your contents page indicates that POWER includes former publications, namely "Operating Engineer" and "The Stationary Engineer." Quite frankly, I don't think you're giving the operating-engineer reader a fair shake in being so highbrow.

I've gotten a lot of help from POWER over the years, particularly from your special reports, but I reach less eagerly for POWER on delivery day because of your accent on articles for engineers who *design* and *manage*. How about giving more space to solid info useful to engineers from assistant plant engineer to the lowly fireman?

F H LAWRENCE, *Kingston, Ontario*

. . . May I suggest that you consider changing your editing style? It's all very well to present articles that are "readable" but does it have to be done at the expense of good technical writing?

I've been reading POWER since I saw my first copy in our college library and was impressed by its technical level. Over the 14 years since I graduated, you've shown a tendency to lower your sights in giving busy engineers the caliber of technical articles they need to stay abreast of the field.

G T PERRINE, *Santos, Brazil*

. . . Your special report is tops (*Electrical Conversion*, December 1959, p 67-90). As an electrical engineer—retired—I've often wished POWER would publish more articles dealing with my field. But I will say this: Whatever you have published has been the cream of the crop.

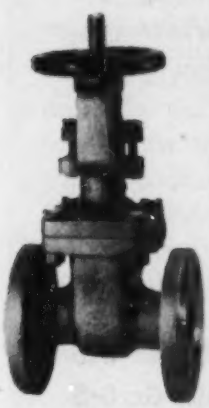
I'm aware that you cover a broad field of power services and you do it well. I have a lot of time to read here in sunny Florida and I'm in a position to compare the quality of POWER with a dozen or so other technical magazines. You have something each month for each level in the power plant and on through to company brass. Keep it up. The younger men coming along can use it.

F X HARRIGAN, *St. Petersburg, Fla.*

For 99 out of 100. . .

Selection of Stainless Steel Valves can be as simple as selection of Bronze and Iron valves

HOW to keep it simple? Don't let the wide selection of stainless steel alloys "throw you"!

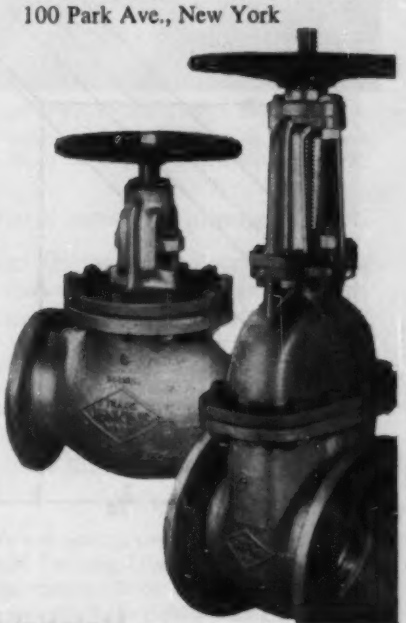


Most of the alloy specs were developed to meet certain highly specialized and rather uncommon needs. Only 1 out of 100 valve users can make practical use of many of the alloys. *Actually, just two or three of the different available alloys will give a big majority of valve users all they want and need.*

You can judge DESIGN differences between the various "makes" exactly as you do it with Bronze and Iron valves. Look them over and compare. Basically, of course, a Stainless Steel valve is designed and constructed very much like other valves.

What is left to worry about in addition to Material and Design? The same factors you consider in buying ANY valves for long, dependable performance: Are the valves made merely good enough, or to a standard that demands an extra-measure of quality? How good are the castings? How precise and perfect is the machining? How rigid is the inspection and testing during manufacture? These are the factors which specs can't cover. Some of them you can't see when you look at the valve. But you KNOW how to make sure they measure-up to peak standards. You know that the name JENKINS VALVES and the famous Jenkins DIAMOND trademark have been the highest assurance of quality for nearly a century.

Specify *"Jenkins"* as well as the metal alloy to assure fullest satisfaction. Your Jenkins Distributor has patterns and alloys to satisfy most industrial needs. Of course, they meet valve industry specifications and the high standards established by leading users of stainless steel valves. Jenkins Bros., 100 Park Ave., New York



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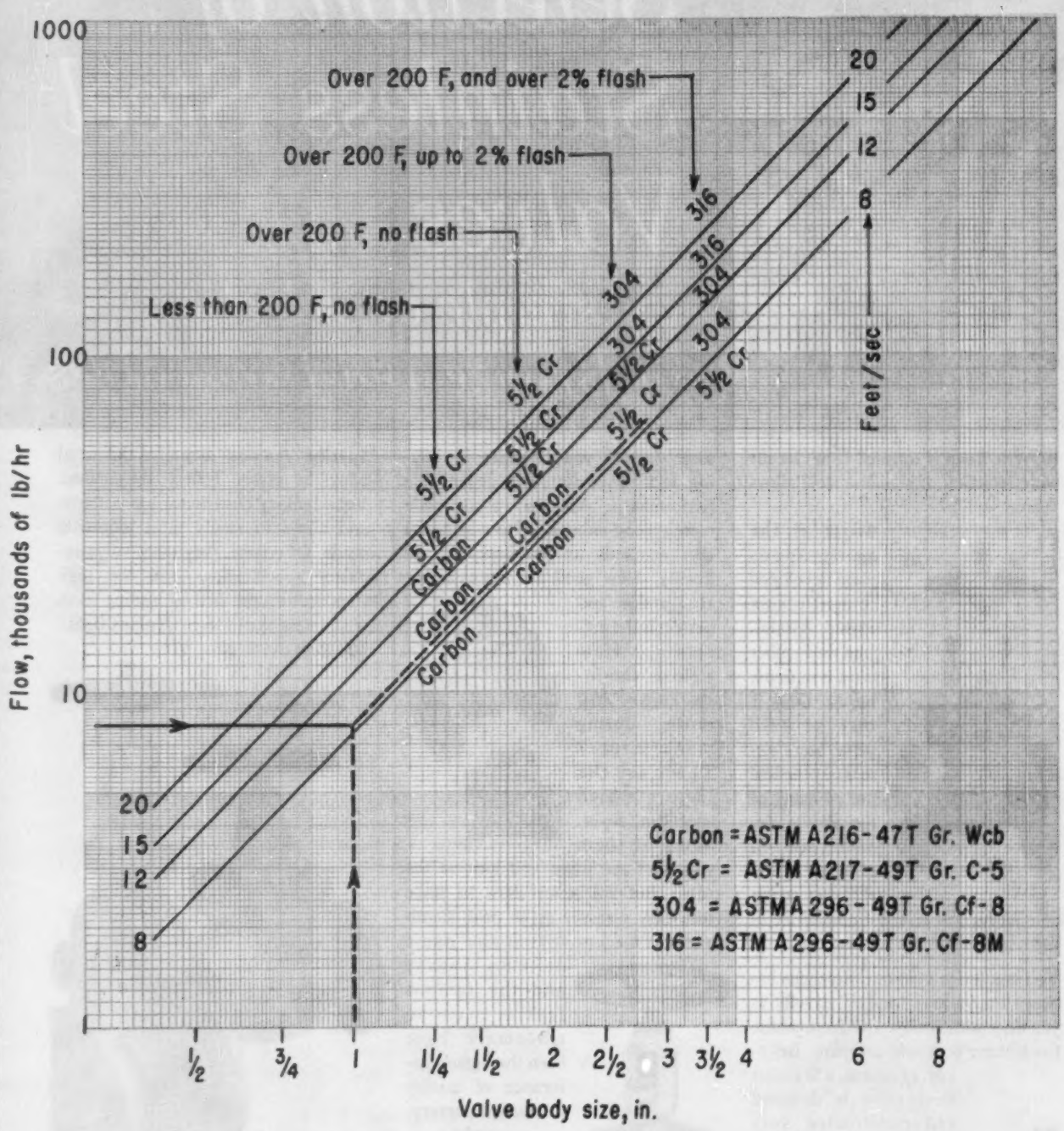
For more facts circle 245 on Reader Service card, p 101

Power's data sheet

No. 329



Material-selection chart for throttling valves

MORE ON THIS SUBJECT appears on pp 65-67 of this issue. For a complete roundup of design tips covering selection of heater-drain controls, see Part 1 of article in POWER, December 1959, pp 91-93

Chart is conservative guide to valve-body material selection for flashing service. To use, enter chart with valve size, flow rate. Extend intersection point parallel to velocity line to service zone. Intersection zone lists recommended material.—J R BERMINGHAM, *Lyndhurst, N. J.*

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News and Notes on...

Good Packing Practice

JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

Subject of the month: Trouble-shooting Packing Problems

Question:

How can you pinpoint the cause of a premature failure?

If you carefully examine used packing, a correct interpretation of the damage will often suggest exactly what caused a premature failure.

Generally speaking, the reasons fall into three areas: (a) the wrong size or style packing was selected for the particular service conditions, (b) the packing was not properly installed, or (c) the equipment requires maintenance. And any of these three conditions can not only result in premature packing failure . . . but can lead to other headaches resulting from poor performance of equipment.

Let us review some of the most common types of packing failures and their causes . . . easy to recognize through a careful inspection of the damaged packing.

1. ***Damage:*** Excessive reductions in the cross-section of the packing.

Possible cause: Bearing worn, or other shaft misalignment result in eccentric movement such as shaft "whip."

2. ***Damage:*** Wearing face of the rings dried and charred, but the rest of the packing is still in good condition.

Possible Cause: Either lack of proper lubrication, or the packing was not designed to withstand speed of movement involved, or the temperature range of service encountered.

J-M #7 Centripac® Packing shown here is designed specifically for single-stage centrifugal pumps in the process industries. Speeds to 3600 rpm; temperature to 500F.

3. ***Damage:*** One or more rings missing from set.

Possible Cause: Bottom of the stuffing box is badly worn, and allows the packing to extrude into the system, causing possible contamination.

4. ***Damage:*** Wear on outside diameter of the packing.

Possible Cause: Rings rotating with the shaft, or coming loose in the box. Choosing the correct size of packing will eliminate this problem.

To solve any sealing problem, call on your local J-M Packing Distributor or Johns-Manville representative. They are equipped to help you select the right packing for the job—one that insures long, trouble-free service. For information, write to Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE

For more facts circle 246 on Reader Service card, p 101

Technical briefs . . . Latest engineering

Russians discuss turbine development, supercritical designs, combined cycles

Steam turbines of the Khar'kov Turbine Works—on the 25th anniversary of the Works, *L A Shubenko-Shubin, Khar'kov Turbine Works, U.S.S.R.*

During 1935 the Khar'kov Turbine Works began building 50-mw machines from General Electric drawings. In 1938 the first 1500-rpm 100-mw units were designed for 410-psig 750-F initial steam.

After the war, in 1945, a line of 1280-psig 930-F turbines was laid out, and in 1948 the first 25-mw machine went into service. Although mechanically successful, these units missed expected performance by about 5%. A change in the blading design of the 100-mw 3000-rpm model in the line gained this back, and the 25-mw model was redesigned with a gain of about 8% in performance.

In 1958 a 150-mw turbine went into service designed for 1850 psig, 1050 F with reheat to 1050 F.

A 100-mw machine is now under design for 4250 psig, 1200/1050 F with a backpressure of 50 psig. Temperatures up to 1470 F are considered feasible. This 100-mw machine is to be the prototype for a 300-mw 4250-psig 1200/1050/1050 F single-shaft machine for 1960 and a 600-mw double-shaft machine for 1962-'63. *Teploenergetika, 1959, No. 2*

Some problems of the thermal circuits of boiler-turbine units for supercritical-steam conditions, *A E Gel'tman, Central Boiler Turbine Institute, U.S.S.R.*

Optimum feedwater temperatures in supercritical-pressure power units were studied using a 300-mw (4250 psig, 1200/1050/1050 F) cycle as the basis. Constant and variable boiler-outlet-gas temperature investigations showed that fuel economy suffered where gas temperature was permitted to vary with feedwater temperature. But capital investment can be reduced with variable gas-outlet temperatures in low-fuel-cost areas, where highest-possible fuel economy is not a must.

Studies of optimum feedwater temperatures pinpointed 540 F as best in high-fuel-cost areas. With low-cost fuel this can be reduced to about 465 F.

Turbine-driven boiler-feed pumps proved best, and there was no significant difference between paralleling the turbine with the h-p or i-p sections of the main turbine. But best economy was achieved where cold-reheat steam was used and the boiler-feed-pump turbine exhausted to a stage heater. Because of physical complications, however, future designs will provide for hot-reheat steam to drive the feed-pump turbine, exhausting to the main turbine. *Teploenergetika, No. 3*

Steam-gas condensing power stations and their comparative efficiencies, *M L Zaks, Moscow Civil Engineering Institute and A V Stolyarov, Power Institute, U.S.S.R.*

Combined steam and gas-turbine cycles are compared to straight steam on an efficiency basis. In all cases natural gas is fuel. In the combined cycle a pressurized boiler is gas-turbine combustion chamber and flue gases drive the gas turbine.

Combined boiler and gas-turbine combustion chamber weighs only .55 to .70 lb per lb of steam generated—about 25% of an ordinary steam boiler.

On the basis of equal excess air, initial steam conditions, fuel consumption and outlet-gas temperatures, combined cycle efficiency gains were greatest in medium- and high-throttle-pressure stations. *Teploenergetika, 1959, No. 3*

Some methods of reconstructing steam-turbine-electric power stations using steam-gas circuits, *D P Gokhshteyn and G P Verkhivker, The Odessa Technological Institute, U.S.S.R.*

As more steam-electric power plants are converted to natural gas, station output can be increased by installing open-cycle gas turbines combined with the existing steam units. Several schemes are studied, advantages and disadvantages of each cited.

In most cases, power output for a given steam consumption is increased about 20%. Cycle efficiencies of 34 to 36% are achieved—a gain of up to 13% over the corresponding steam cycle. A combined 140,000-kw unit with initial steam conditions of 1280 psig, 900 F produces an efficiency only 15% less than a 140,000-kw supercritical double-reheat unit with initial steam at 4250 psig, 1200 F.

Combined cycles can burn mixed fuels—gas in the gas turbine and solid fuel in the steam boiler. This is especially useful in stations associated with the steel industry. *Teploenergetika, 1959, No. 5*

An investigation of pressure-control systems for a large drum type boiler operating as a unit with a turbine, *L S Shumskaya and K A Labutina, Central Boiler Turbine Institute, U.S.S.R.*

Investigation covered four pressure-control systems: (1) Single-element control sensing superheated steam pressure (2) 2-element control sensing change and change rate of superheater pressure (3) 2-element control sensing rate of superheater pressure

change and steam consumption and (4) 3-element control sensing change in superheater pressure, rate of change and steam consumption. In all cases, two feedback arrangements for variable-speed servo motors were considered.

Investigations showed the best arrangement was 3-element control. These studies served as the design basis for four large boilers operating in the unitized systems. *Teploenergetika, 1959, No. 2*

Water treatment

Five years' weak-base anion-resin experience on the Ohio River, *J K Sargent, Jones & Laughlin Steel Corp and G A Bowman, Dravo Corporation*

Operating data on weak-base anion exchangers at the Aliquippa Works of Jones & Laughlin Steel cover a variety of resins and regenerant combinations. System includes cold-water reactors, sand filters, four cation and four anion exchangers. Tin-plating process requires water with specific conductance below 35 micromhos.

Capacity of weak-base anion exchangers fell off with original charge of phenol-formaldehyde resin regenerated with soda ash. In a variety of combinations, polystyrene and epoxy-polyamine resins were tried. Sodium-hydroxide as the regenerant has been used alternately with the various resins. The annual cyclic effect of throughput temperature has been correlated with operating data.

Currently, half of the beds use epoxy-polyamine resin regenerated with sodium-hydroxide. In the others, polystyrene is regenerated with soda ash. These two combinations appear optimum and a direct comparison is possible. *20th Annual Water Conference—1959*

Experiences with ammonia regeneration of weakly basic anion resin in a large demineralizer plant, *S B Applebaum, Cochran Corp and F Fast, Mobile Oil Company*

After several resins were tried at the Paulsboro Refinery of Mobile Oil, polystyrene-polyamine proved most stable. Soda ash was originally used as the regenerant, but caustic soda was later substituted since it increased resin capacity. After five years' operation, resin-exchange capacity leveled off at 15-kg tma (as $CaCO_3$) per cu ft.

Rinse-water requirements during the period rose from 105 to 342 gal per cu ft of resin. Use of ammonia hydroxide to reduce rinse requirements proved successful: requirements dropped to 85 to 100 gal per cu ft and resin capacity remained at 15 kg per cu ft. Rinse time was cut in half.

Directions for ordering these papers on page 100

Possible difficulties of odor and waste disposal using ammonia hydroxide were overcome. Corrosion was not a problem since ammonia concentration in the demineralized effluent was kept below 0.5 ppm. *20th Annual Water Conference—1959*

Organic fouling in anion exchange, *J K Rice and D E Simon, Cyrus Wm Rice Company*

Organic fouling of strong-base ion-exchange materials causes a gradual loss of capacity. While this loss is usually 0.1 to 0.5%, it can go as high as 2% per cycle in extreme cases. Past studies of restoration methods have produced little of practical value to average users. Replacement of fouled resin is still the most widely practiced solution.

Test runs show that HCl is by far the most effective single treatment in restoring strong basicity. But HCl has almost no ability to restore total capacity. Use of other extractants such as a caustic salt and nitric acid further improves strong basicity after initial treatment with HCl.

Composition of organic-fouling materials is difficult to determine and undoubtedly varies widely between locations. It is felt that the answer to the fouling problem lies not only in pretreatment but also in additional exploration of resin-restoration methods. *20th Annual Water Conference—1959*

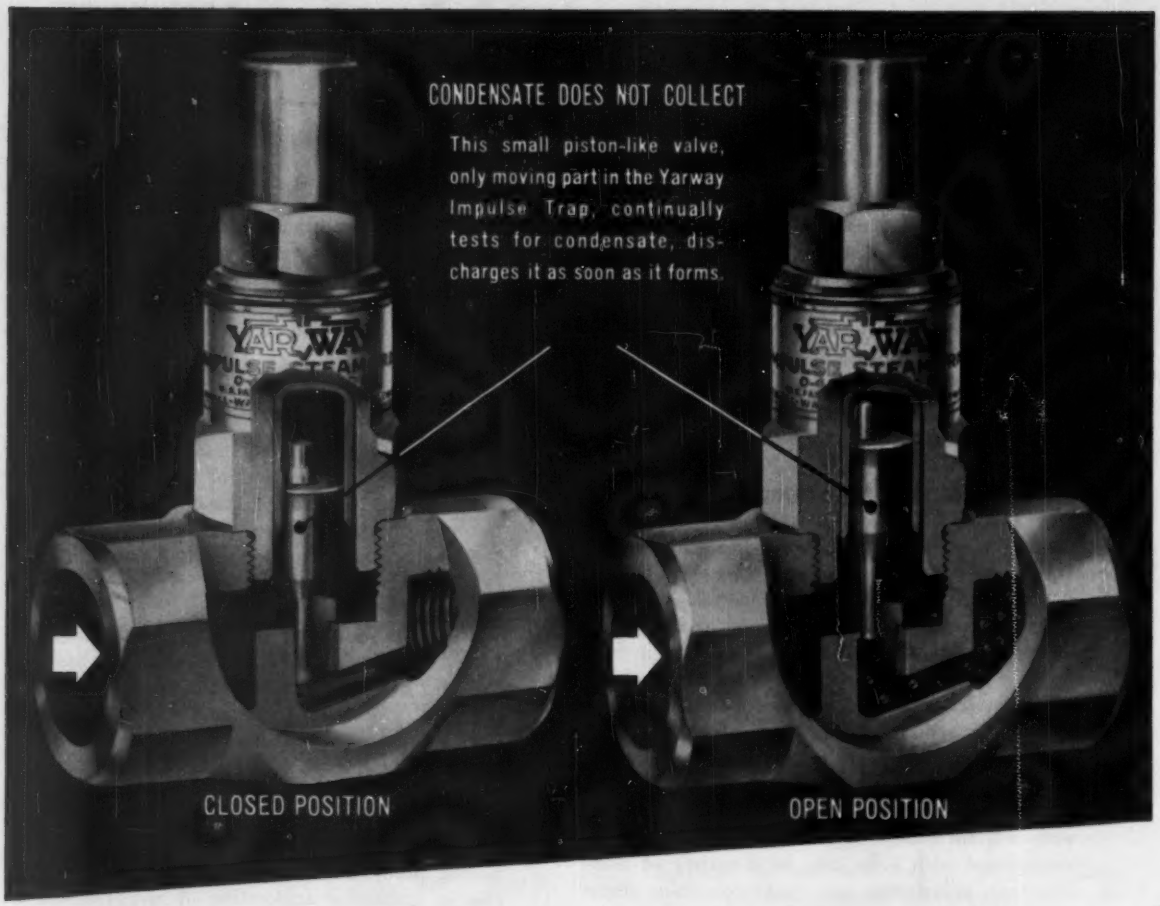
Experiences with the use of stainless-steel condenser tubes at the Rivesville Station of Monongahela Power Company, *E R Long, Monongahela Power Co*

The Rivesville Station is located on the Monongahela River where mine drainage makes pH as low as 3.0 during periods of low run-off. Copper-alloy condenser tubes (16 Bwg) lasted less than seven years on 90% duty. Cleanliness factors above 60% were impractical due to high cost of cleaning.

Thin-walled AISI 304 tubes (22 Bwg) installed in a 55,000-sq-ft condenser showed continuous performance eual to 85 to 124% cleanliness. This value in stainless steel has a heat-transfer rate well exceeding the 50 to 60% copper-alloy equivalent.

Stainless-steel tubes produce considerable improvement in a condenser with a tube-fouling problem and where cleanliness is more easily maintained using stainless steel. Some of the improvement at Rivesville may have been due to the self-cleaning effect of higher tube velocities. Where 6.5 fps was normal with copper-alloy tubes, 7.0 fps was the average with stainless steel. This gain resulted from a lower system resistance.

Stainless-steel-tube life expectancy is 30 years compared to an actual life of seven years with copper alloy. *20th Annual Water Conference—1959*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OPEN POSITION

Yarway Impulse puts the heat on steam trap freeze-up problems

Cold weather means nothing to a Yarway Impulse Steam Trap. *Its design offers full protection against freeze-ups,* which cause costly production delays and extra maintenance work.

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More **technical briefs**

Cooling towers

Remote control of cooling-tower fans, *R J Davis, Black and Veatch Engineers*
Where cooling towers must be used with large turbine-generators, cost of tower operation represents a considerable portion of total auxiliary power. On a 175,000-kw unit it may run as high as $46,000 annually. Magnitude of possible savings justifies a control system to minimize costs by varying fan operation according to station load and weather conditions.

Cost of a direct-controlled system may be excessive in a large unit due to distance between station control room and the fans themselves and the large number of cables that must be installed. On the other hand, cost of a supervisory system does not increase greatly with long distances. In each type of installation a point exists beyond which a supervisory system is less expensive than a direct-controlled system.

The code-selector supervisory system provides a variety of continuous operating data on the cooling-tower circuit besides controlling the fans. A specific installation of a code-selector system is described in detail. *AIEE 59-5122*

Cooling-tower specification and design, *G M Anderson, Fluor Products Company*
Importance of cooling towers increases as available industrial sites with ample water supplies become more and more scarce. For the same cooling capacity, costs can vary widely depending on weather data supplied to the manufacturer. A high degree of accuracy in weather prediction, although difficult, will pay off in lower cost and more satisfactory results.

Early mechanical-draft cooling-tower designs used forced draft. Today, majority are either counterflow or crossflow induced-draft type.

Details of tower performance specification are given as well as effect on cost of varying wet-bulb and cold-water temperatures. Materials depend on water and climatic conditions; they include fill, structural framework, sheathing, water-distribution system, mechanical equipment and hardware. *ASME 59-PET-6*

Automatic control of cooling-tower water quality, *J K Kintigh, Black and Veatch Engineers*
Satisfactory cooling-tower operation depends on adequacy of circulating-water treatment. Treatment includes (1) prevention of corrosion and control of scale formation (2) elimination of slime and algae (3) protection of cooling-tower wood (4) prevention of silt fouling and (5) water conservation.

Chemical deconcentration of circulating water by controlled blowdown or overflow with constant makeup maintains acceptable levels of composition. Internal treatment, including pH control and dianodic inhibitors, reduces corrosion. Settling basins are occasionally used as a pretreatment where required by turbidity and silt in raw water.

Handling and use of chlorine as an anti-algae agent is discussed. The deteriorating effect of chlorine on cooling-tower wood is detailed.

An automatic system for complete circulating-water treatment involving all five of the necessary functions is described. *AIEE 59-5123*

Boiler-tube materials

Material considerations in superheater designs, *P M Brister and G E Emmanuel, The Babcock & Wilcox Company*
Importance of adequate superheater design increases with temperature and cycle efficiency. In a modern 2400-psig reheat unit, the superheater and reheater section absorb 48% of total heat added in the steam generator. Superheaters operating at 1050 F must withstand severe fireside conditions to maintain sufficient temperature difference and keep down required surface.

Metal temperature and material requirements of superheater designs are reviewed. These include (1) high-

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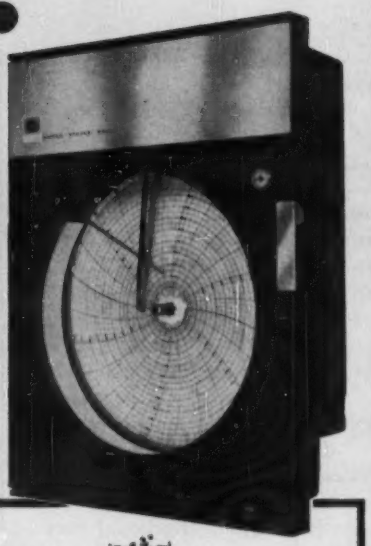

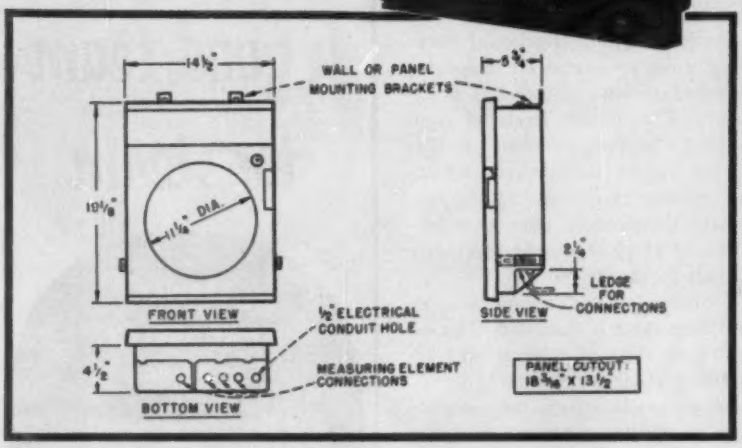

Now, the time-proved, field-proved United States Gauge 12-inch pressure and temperature recorder with completely new, trim, practical exterior design . . . including many important features found only on higher priced instruments. Now, outside and in . . . the USG Recorder offers still more quality, performance and advantages at a money-saving price.

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Technical briefs

temperature strength (2) surface stability (3) structural stability (4) fabrication and (5) material cost vs power-plant economics.

Specific suggestions for material limitations meeting these requirements are included. A table gives maximum allowable metal temperatures for tubes, pipe and hangers which come in a variety of materials. *ASME 59-PWR-11*

Fireside corrosion of superheater and reheater tubing, *J Jonakin and J T Reese, Combustion Engineering and G A Rice, Electric Energy, Inc*

Fireside corrosion of superheater and reheater tubes at the Joppa Station of Electric Energy has been studied in detail. A special probe was developed to determine corrosion resistance of various test metals by exposing them at controlled temperatures inside the furnace.

Temporary stainless-steel protective shields are installed to retard corrosion until test results indicate proper corrective measures. Shields of several gages and materials were tried; 14-gage AISI 310 was finally selected.

Corrosion wastage is found to be directly associated with ash constituents having low melting temperatures. Wastage is greatest where metal temperature is 1050 to 1100 F and decreases both above and below. Deposits adhering to the tubes are sintered, sticky flyash particles. Sulfurous gases combine with tube deposits and form complex alkali-iron sulfates which are molten at temperatures corresponding to maximum metal wastage. *ASME 59-FU-5*

Control valves

The orifice plate as a primary element, *C A Prior, Diamond Alkali Company*

Orifice plates are still the most widely used means of flow measurement. They are simple, inexpensive and easy to install, and there is much data available for their proper use.

But orifice plates do have several disadvantages. Small errors in their construction or installation can make

For more facts circle 249 on Reader Service card, p 101

Begins on page 94

accurate flow measurement impossible. Rounding of upstream edge of bore, bowing of plate, dirt and burrs are but a few of the items that can completely ruin accuracy.

Much data is available for accurate orifice-plate design and flow calculation. Work is in progress to standardize orifice-plate designs and eliminate the variables that exist between manufacturers. *ISA 5-59*

Other power services

New instrument systems for recording turbine speed, eccentricity, expansion and vibration, *H A Harriman and D M Longenecker, General Electric Company*
Turbine-generator instrument systems are constantly being improved to provide more and more operating data. Speed, expansion, eccentricity and vibration recording devices are standard on machines rated 80,000 kw and larger. They can also be provided as optional equipment on smaller machines.

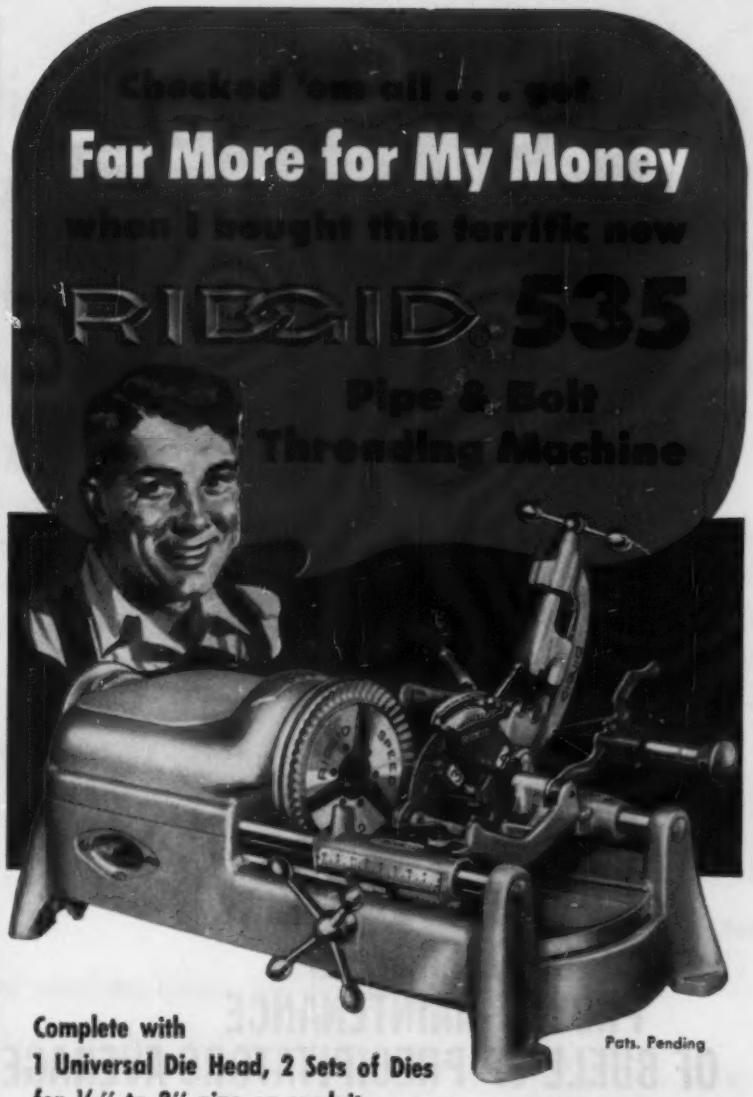
Need for instrument-system reliability is great, especially to instill confidence in the minds of the operators. Then turbine-generator instrumentation produces maximum value for the owners.

Operating details and circuitry of each instrument system are discussed in detail. Representative degrees of accuracy are given: eccentricity while running, ± 1.5 mils; vibration, ± 0.15 mils. *AIEE 59-1109*

Gas turbines, installation and operational problems and performance evaluation, *C Bultzo, Humble Oil and Refining Company*
In spite of improvements in gas-turbine technology, certain problems continue to plague operators.

Lube-oil-system installation practices must be improved to eliminate operating difficulties. Welding of components is a chronic trouble source. Accuracy of instrumentation must be high so operator won't be misled—otherwise he may shut down the machine to look for trouble that doesn't exist. Reverse of this is, of course, possible and even more costly.

Fouling of the axial-compressor



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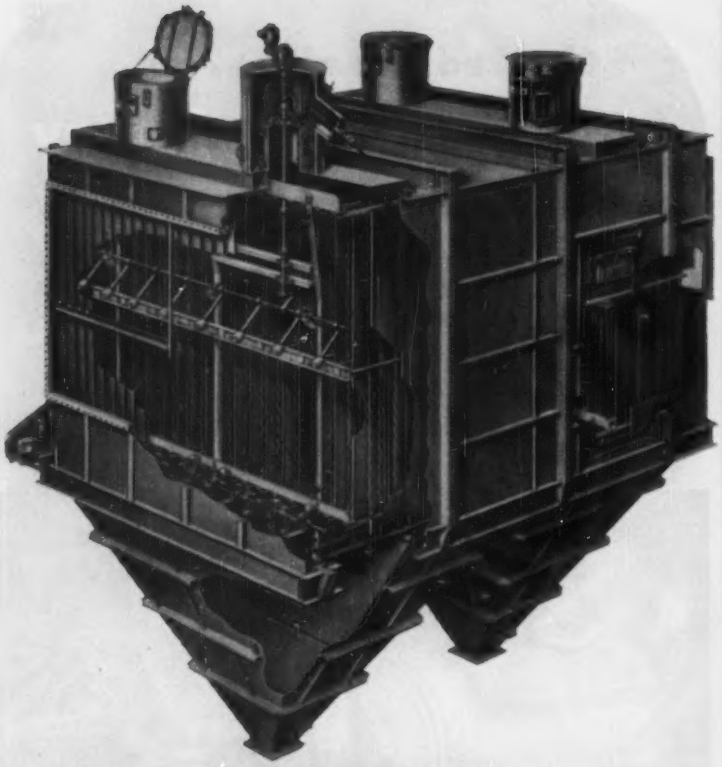

DECADE
OF OPERATION PROVES MAINTENANCE OF BUELL 'SF' PRECIPITATORS AVERAGE LESS THAN 2%

In 10 years of selling 'SF' electric precipitators, the number of replacement parts ordered from Buell has amounted to only 1.17% of the total sales! Even on emitting electrodes, usually the most vulnerable part of a precipitator, replacement has amounted to less than 1% of the original number installed. What do these extremely low percentages mean? Exceptionally low maintenance costs, for one thing, continuous high-efficiency operation, fewer shutdowns and process interruptions. Buell self-tensioned emitting Spiralectrodes eliminate vibration found in weight-tensioned wires. Buell's low maintenance precipitators will provide you with the most satisfactory operating results. They're backed by 25 years of experience in dust collection, with the practical know-how gained on hundreds of installations. Write for descriptive literature. The Buell Engineering Co., Inc., Dept. 50-A, 123 William St., N. Y. 38, N. Y. (Subsidiary: Ambuco Ltd, London, England)

EXPERTS AT DELIVERING EXTRA EFFICIENCY IN DUST RECOVERY SYSTEMS

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Technical briefs

Begins on page 94

blades can reduce machine capability and manual cleaning takes time. One solution, scrubbing inlet air, also serves to cool unit and will increase output on hot days.

Field-performance tests in the form of heat balances require highly accurate instruments to be significant. A sample heat balance is calculated showing factors contributing to error in closure. *ASME 59-PET-9*

Gas-turbine drive for industrial-power generation, *S Z Stys, Brown Boveri Corporation*

Increasing popularity of the gas turbine as a means of industrial power generation is based largely upon its ability to utilize a variety of fuels. Space requirements are fewer than for other drives. Gas turbines are especially suited to locations where cooling water is at a premium.

Several actual case histories are reviewed. Continuous operation to 50,000 hr shows little or no maintenance required. *AIEE CP-59-816*

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American Society of Mechanical Engineers. Contact ASME, 29 W 39th St, New York 18, N. Y. Members, 40¢; nonmembers, 80¢.

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Russian papers. For complete English abstracts contact Office of Technical Services, U. S. Dept of Commerce, Washington 25, D. C. Price: 70¢.

Instrument Society of America. Contact ISA, 313 Sixth Ave, Pittsburgh 22, Pa. Members, 35¢; non members, 50¢.

20th Annual Water Conference. Contact The Engineers Society of Western Pennsylvania, Penn Sheraton Hotel, Pittsburgh 30, Pa. To be published in book form at $10.00.

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New free literature

AIR CONDITIONING, HEATING REFRIGERATION, VENTILATION

101 **Heating coils,** standard-steam, hot-water, steam-distributing and double-distributing types, are featured in 32-p handbook HC-103. Specs, air-friction and temperature-rise charts for pressures from 2- to 30-lb steam, coil-design formulas and piping diagrams are included. American Air Filter Co, Inc

102 **Gas-fired heaters,** furnaces and packaged blowers are discussed in 28-p general catalog SA-5900. Gives specs, dimensional and performance data to aid selection. Includes firm's complete line. Reznor Mfg Company

METALS AND MATERIALS

103 **Aluminum** used as bearing material is subject of 12-p brochure. Tabular data, economic advantages are listed. The Bunting Brass and Bronze Company

104 **Ferrous-metallurgy** basic guide includes characteristics of steel across temperature range of 2960 F, has 4 pp. Tempil Corporation

105 **Alnico VII A** is covered in new bulletin. Magnetic and material characteristics of oriented and non-oriented forms are listed. The Indiana Steel Products Co

MATERIALS HANDLING

106 **Hand chain hoists** are covered with standard specs in 8-p bulletin. Hoist Manufacturers Association, Inc

107 **Conveyors,** feeders, vibrating screens, bin check valves are covered in bulletins 951, 941, 978. Firm's complete line is discussed in 56-p, 48-p and 12-p catalogs. Jeffrey Mfg Company

ELECTRIC GENERATION, TRANSFORMATION AND CONVERSION

108 **Power transformers** for large-substation, transmission-tie and generator step-up applications are described in 44-p publication GEA-6604A. Ratings are from 12,000 to 250,000 kva and up to 230 kv. Dimensions and application info included. General Electric Co

109 **Silicon rectifiers** are topics of bulletins RN459, RN659. International Rectifier Corporation

ELECTRICAL DISTRIBUTION AND PROTECTION

110 **Overload** and fault-current limitations of bare-aluminum conductors are topics of 16-p bulletin. Aluminum Company of America

111 **Automatic overload detector** is topic of 4-p booklet. Wintriss, Inc

112 **Air circuit breakers** for metal-clad switchgear are described in 8-p brochure 3-450. Application and construction details on two new types rated 5 kv, 350 mva and 15 kv, 1000 mva are given. Federal Pacific Electric Co

113 **Re-usable primary battery,** silver-zinc system in full range of sizes from 0.1 to 300 amp-hr, is featured in new bulletin. Yardney Electric Corporation

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114 **Control-transformer** bulletin features quick-reference chart for load determination. Total of 420 calculations are listed. Bulletin 14-B101 has 4 pp, lists dimensions, prices. Acme Electric Corp

VALVES, PIPING, FITTINGS AND SPECIALTIES

115 **Small-tubing analyses** of columbium, tantalum and vanadium tubing are subjects of analysis memo 121. Superior Tube Co

116 **Nuclear-quality** fuel-element tubing is described in spec sheet STC-102. Seamless austenitic stainless-steel types are featured. Superior Tube Company

117 **How to cut cost** by using alloy mechanical tubing is topic of 4-p folder. The Babcock & Wilcox Co, Tubular Products Div

118 **Tubing and pipe** of super-corrosion-resistant alloys are detailed in new bulletin, applications outlined. The Carpenter Steel Co

119 **Magnetic solenoid valves,** electrically controlled, are described in catalog of firm's complete line. Magnetrol Valve Company

120 **Buyers' guide** includes valve comparisons of 16 major manufacturers and valve-trim chart. The Ohio Injector Company

121 **Butterfly-valve designs** for 9000 applications are covered in 4-p condensed bulletin 50-1. Fisher Governor Company, Continental Equipment Co Div

122 **High-pressure boiler-water gages** are covered in spec sheet 358. Gages operate up to 3000 psi. Jerguson Gage & Valve Co

123 **Solenoid-valve** stock list and selection guide is a 16-p booklet with illustrations and flow diagrams of firm's complete line. Automatic Switch Co

124 **Pressure-reducing valves** with range from 250 psi at 450 F in cast iron to 900 psi at 750 F in steel are described in 4-p folder. Atlas Valve Co

125 **"Recommended piping practice"** is an illustrated wall chart including sections on basic valve types, connections, installation, maintenance and operation. Lunkenheimer Company

126 **Cast-aluminum coupling** for joining extruded-aluminum steel-traced piping is described in spec sheet PF-1. Alcast Fittings

127 **Flexible-cushion couplings** ranging from 190 hp per 100 rpm to 2000 hp at 1080 rpm are featured in 12-p bulletin A669C. Dodge Mfg Corp

128 **Branch-connection fittings** are topic of new booklet. Applications, cost comparisons, engineering design data and benefits are discussed. H K Porter Company, Forge and Fittings Div

129 **Brass and steel tube fittings,** tube-working tools and hose are covered in 16-p condensed catalog C-301. The Weatherhead Co

130 **Branch connection fitting** catalog TF-1-59 covers firm's complete line. H K Porter Company, Inc

continued

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NEW FREE LITERATURE continued.....circle key numbers, page 101, for your copies

131 **Molded packings** are topic of 8-p bulletin GTR-759. Includes reference chart, applications shown in schematics, cutaway installation drawings and tabulated engineering data. Greene, Tweed & Co

132 **Self-lubricating packings** are featured in price list and catalog SLP-659. Tables on weights and lengths, application chart are given. Greene, Tweed & Company

133 **Self-cleaning pipeline strainer** is introduced in 2-p bulletin 1210-1. Sarco Co, Inc

134 **Air-hydraulic boosters**, pipe-thread fittings and piping-problem case history are subjects of new brochures. Flick-Reedy Corp, Tru-Seal Div

135 **Cylinders and valve - cylinder** combinations—air, water and oil types—are covered in 24-p bulletin 91017. Specs included. Airmatic Valve, Inc

WATER TREATMENT

136 **Feedwater control systems**, air-operated 2-element and single-element type, are illustrated by diagrammatic drawings in 4-p bulletin 531. Gives selection chart. Bailey Meter Company

137 **Boiler-water control systems** for steam boilers are presented in illustrated brochure. Performance tests and maintenance costs included. Sparkler-Filtrion Corp

138 **Water - and liquid - treatment** units, clarifiers and thickeners, are described in new bulletin WC-123. Graver Water Conditioning Co

139 **Modern water-treatment** developments for boiler and nuclear plants are topics of reprint 123. Cochrane Corp

140 **Treatment of condensate** by scavenger mixed-bed demineralizers is discussed in reprint 117. Cochrane Corp

141 **Zeolite-softener** care and operation is subject of water-conditioning data sheet. Betz Laboratories, Inc

142 **Water treatment** for cooling towers and evaporative condensers in small air-conditioning systems is discussed in new-product bulletin 7; 1-package treatment is introduced. Metropolitan Refining Co, Inc

143 **High-color low-turbidity** water clarification is discussed in reprint T-176. Design considerations and operating experiences are featured. Graver Water Conditioning Co

144 **Cooling towers** are covered in 4-p bulletin KT-104. Construction, performance details and specs included. American Air Filter Co, Inc

145 **Winter operation** of outdoor cooling towers is topic of 2-p bulletin 598. Water Service Laboratories, Inc

146 **Digester floating pontoon covers** are detailed in 40-p booklet B-100. Specs, installation data and informative drawings are given. Chicago Pump Company

PRIME MOVERS, I-C ENGINES

147 **Centerline - mounted** steam turbine with steam inlet pressures up to 875 psig for requirements to 1000 hp is featured in 2-p bulletin. Dean Hill Pump Company

148 **New fuel system** which permits diesel engines to burn gaseous fuels including natural gas, sewage gas and diesel oil is explained in brochure EG-B46. Enterprise Engine & Machinery Co

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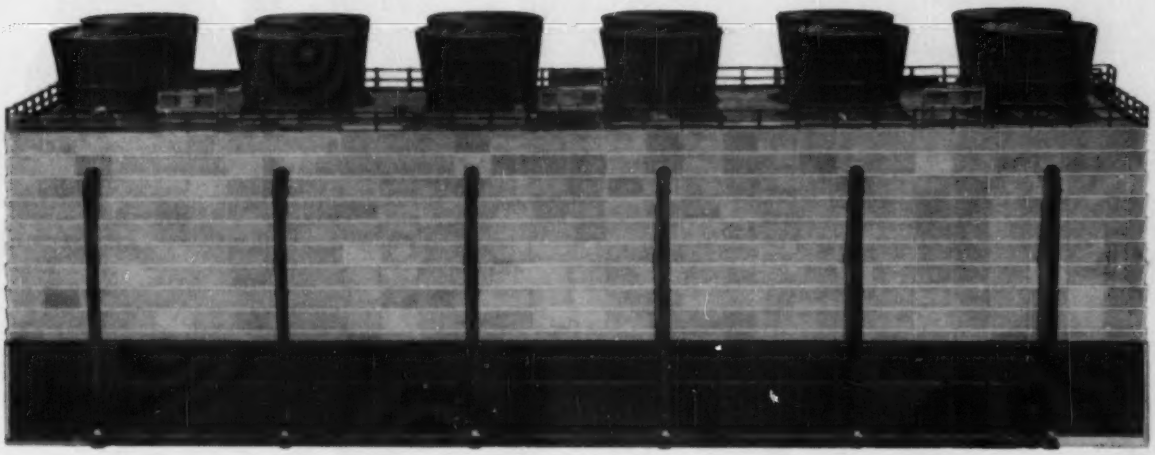

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WASHINGTON, D. C., Walter E. Campbell Co., Inc.
WICHITA, Kans., General Metals, Inc.

Free literature

Begins on page 101A

STEAM GENERATION

149 **Recirculated gas** and its relation to boiler design and operation are topics of 16-p bulletin G-96. Method for obtaining proper proportioning of heat within a steam generator is featured. The Babcock & Wilcox Co, Boiler Div

150 **Packaged steam generator,** stoker-fired type, is featured in bulletin PG-59-4. Foster Wheeler Corporation

INSTRUMENTATION

151 **Thermal element,** snap-acting disk type, which actuates thermostats, circuit breakers and motor protectors is detailed in 29-p booklet. Non-disk-actuated controls are included. Texas Instruments, Inc, Metals & Controls Division

152 **Recording annunciator** for process temperature, flow, pressure and level is topic of 4-p bulletin 102A. Panellit, Inc Panalarm Div

153 **Precision measuring tools** and instruments guide and catalog is 96-p illustrated booklet. Price list, specs and detailed diagrams of firm's complete line are given in catalog 35. Scherr-Tumico Co

154 **Gas-sampling systems** are described in 8-p brochure 59-B651. The Hays Corp

155 **Rotameter** for purge service is topic of spec sheet D8-130-1. Brooks Rotameter Company

156 **Glass-tube purge meters** are described in new bulletin TP-1-RM. Range is from 0.01 to 30.0 gal water per hour or 0.12 to 125.0 cu ft air per hour. Wallace & Tiernan, Inc

157 **Pneumatic transmitters** for measurement of level over range of 1-in. to 2000-in. H_2O are covered in 4-p product spec sheet P31-1. Bailey Meter Company

158 **Leak detector** for vacuum and pressure systems is topic of 12-p brochure GEZ-2939. Operating principles, maintenance, installation and application info given. General Electric Company

159 **Data-processing equipment** including digital data processing, analog and digital computing systems is topic of 48-p preliminary technical publication N-07(1). Leeds & Northrup Co

160 **Analog-computer-control systems,** solid-state type, are featured in new brochure MSP-163. Applica-

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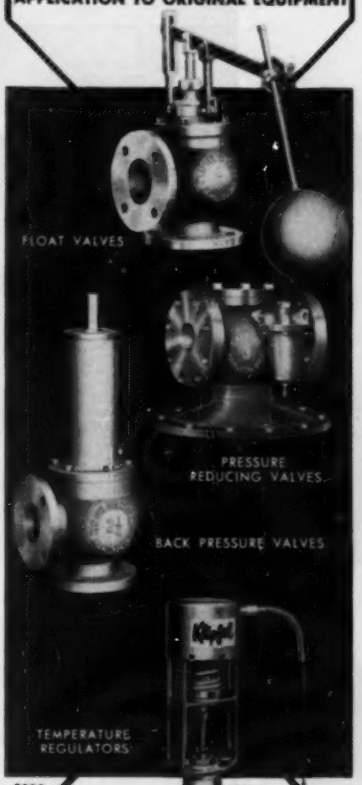

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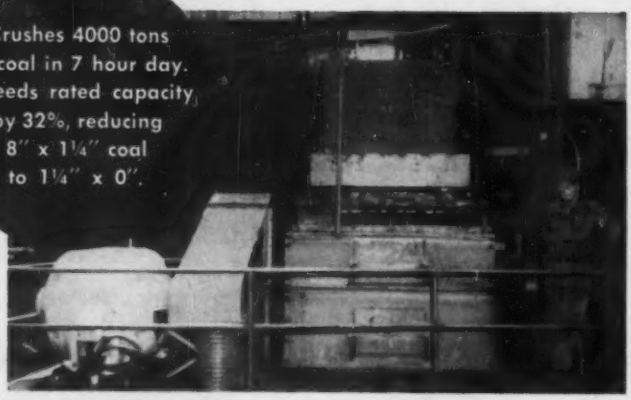

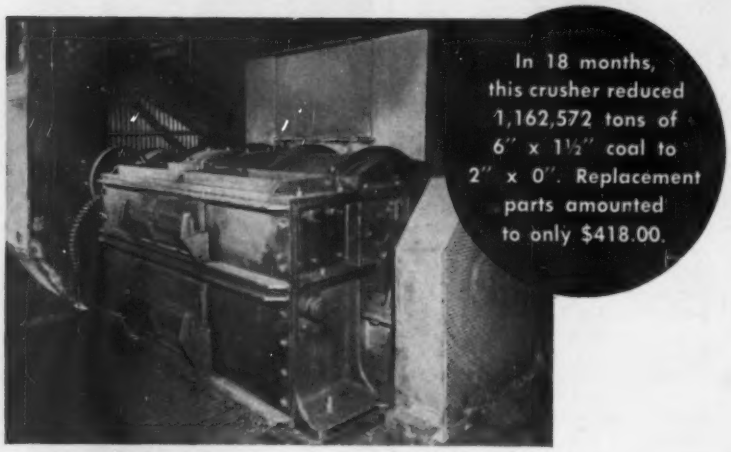

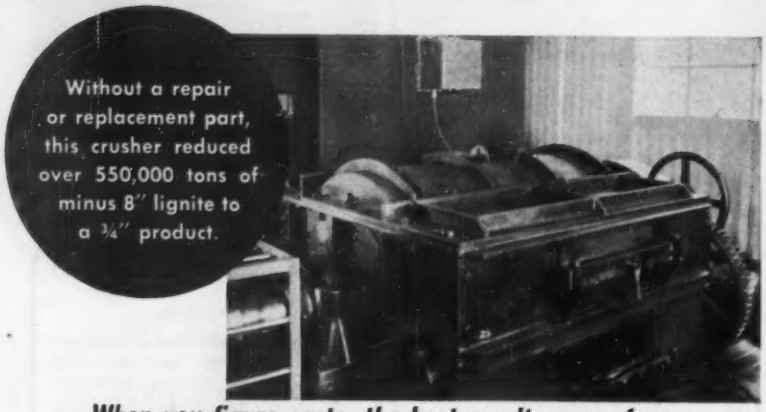

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ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

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Free literature

Begins on page 101A

tion and installation info given. Hagan Chemicals & Controls, Inc

161 **Thermocouple well** catalog GL02-1 has 16 pp, provides selection info. Minneapolis-Honeywell Regulator Company, Industrial Division

162 **Annunciator systems** are featured in 36-p catalog 659. Operation and application info for various industrial uses are included. Paul J Steffen Company

163 **Annunciator systems** and process-control information systems are topics of 52-p brochure 100C. Equipment photos, charts and diagrams aid selection. Panellit, Inc, Panalarm Div

164 **Electric data system** for logging, monitoring, computing and optimizing control is described in 12-p booklet. Construction and operation details, technical data included. Hagan Chemicals & Controls, Inc

165 **Compiling routine** and translator for firm's electronic computer are detailed in 18-p bulletin. Royal McBee Corp, Data Processing Division

WELDING

166 **Gas-welding rods** are topic of 8-p bulletin DH-1277-B. American Chain & Cable Co, Inc

167 **"Guide to better welding"** is 71-p illustrated booklet covering technology and economics among other aspects of multi-arc welding. Principles, uses and advantages are explained. Cross-referenced index allows use as reference book. J B Nottingham & Co, Inc

PUMPS

168 **50th anniversary celebration** brochure displays new products for industrial waste treatment, sewage pumps. Chicago Pump Co

169 **Medium-pressure** and close-coupled petrochemical and cryogenic transfer pumps are topics of spec sheets. Models 2000 and 3000 are detailed in charts. Turbocraft, Inc

170 **Proportioning pump** for treating process water is featured in spec sheet 1210.20-1. Description of 1/6-hp feeder includes a feeder-capacity chart. B-I-F Industries, Inc

171 **Filter-pump units** with capacities from 50 to 2700 gpm are

For cooling water systems, the latest word is ENDCOR®

ENDCOR – new from Dearborn's research laboratories, gives better corrosion control at lower cost in open recirculating cooling water systems.

ENDCOR – promotes rapid film formation . . . is completely stable against oxidizing agents.

ENDCOR – sharply reduces corrosion rates and deposit formations . . . minimizes sludge adherence to heat exchange surfaces.

ENDCOR – permits operating any open system at higher pH readings . . . saves on acid.

Developed after exhaustive experiments, ENDCOR has been incorporated in Dearborn's Polychrome® and non-chromate treatments and successfully tested under severest laboratory and operating conditions in customer plants for over a year. Available now in powder or briquette form. Your Dearborn engineer will be happy to fit these new treatments to the specific needs of your system. Call him today or write for detailed Technical Bulletin.

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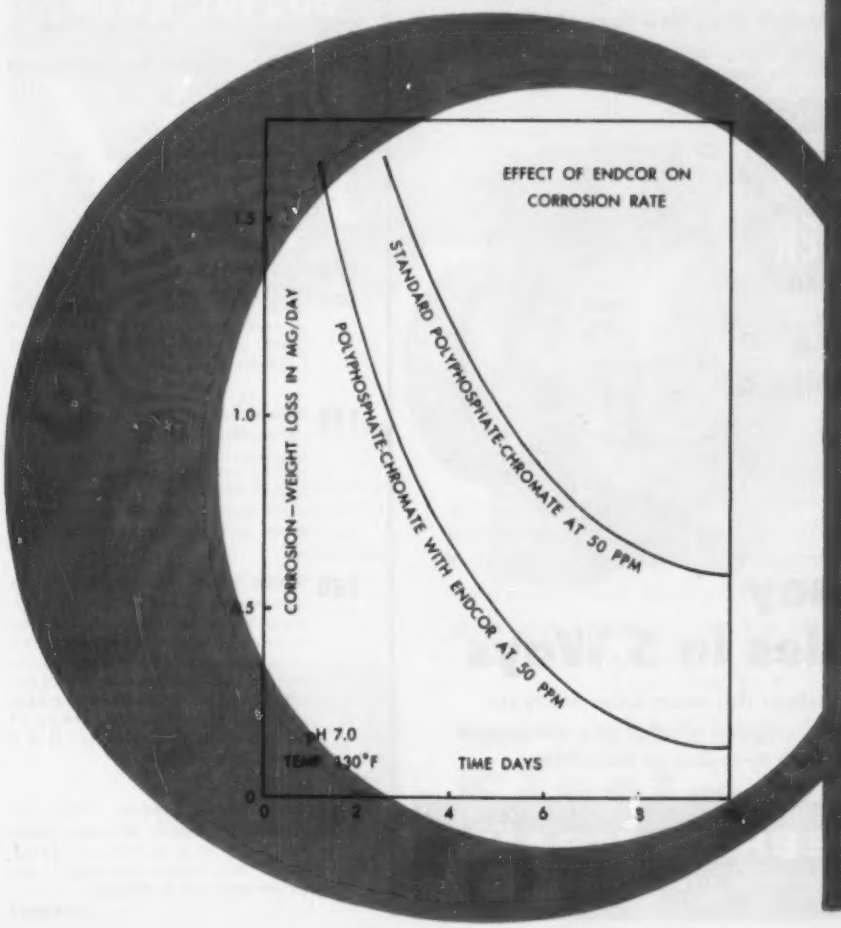

pioneer in the science of corrosion control

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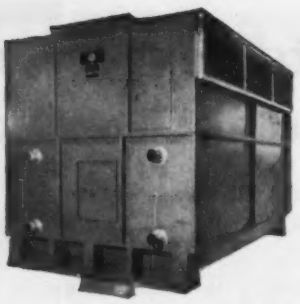
For more facts circle 256 on Reader Service card, p 101

This Self-Contained Fluid Cooling System

... gives most accurate temperature control



Applied in cooling industrial machines or processes to temperatures approaching the ambient wet-bulb, the NIAGARA *Aero* HEAT EXCHANGER is independent of any more than a nominal water supply or disposal. The coolant system is a closed one, free from dirt and maintenance troubles.

Heat is removed from your process *at the rate of input,* giving you precisely the temperature you require and assuring the quality of your product. Heat may be added to prevent freezing in winter or for better control in a warm-up period. Liquids or gases are cooled with equal effectiveness.

Heat is rejected outdoors. Only the little water evaporated on the cooling coils in the air stream, or discharged to prevent hardness build-up, is consumed.

Niagara sectional construction saves you much installation and upkeep expense, gives full access to all interior parts and piping. Your equipment always gives you full capacity and "new plant" efficiency.

Write for Niagara Bulletin No. 132 for complete information

NIAGARA BLOWER COMPANY

Dept. P-1, 405 Lexington Ave., New York 17, N.Y.

District Engineers in Principal Cities of U. S. and Canada

For more facts circle 257 on Reader Service card, p 101

ENCO TYPE E REGISTER

FOR OIL and/or GAS FIRING

Saves Money and Troubles in 5 Ways

Details of the ingenious features that assure these results are available in literature — gladly supplied whether you contemplate buying or just want to keep up-to-date on this subject.

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THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

Free literature

Begins on page 101A

detailed with specs, dimensions, and applications in 8-p bulletin M-1. Sethco Manufacturing Corp

172 **Free-piston pump** with 100-gpm capacity is topic of 4-p brochure. The Crossley Machine Company

173 **Turbine type pumps** with capacity range up to 150 gpm, pressures to 300 psi and temperatures to 275 F are described with charts and tables in 8-p bulletin S-111. Dimensions, construction and engineering specifications are also given. The New York Air Brake Company, Aurora Pump Div

MECHANICAL POWER TRANSMISSION

174 **Motor reducer** for output speeds to 1 rpm, 75 hp is detailed in 4-p supplement 3100.01. The Falk Corporation

175 **Variable-speed sheaves** which will hold constant driven speed under varying torque loads are topic of 8-p bulletin 8102. Tables aid selection. T B Wood's Sons Co

176 **Gears** for speed-reduction or speed-increasing service on high-hp transmission applications are described in 8-p bulletin 3401. De Laval Steam Turbine Co

177 **Spring-loaded pulleys** and adjustable motor bases are introduced in 4-p brochure 81-1. Maurey Mfg Corp

178 **Bearing blocks** and takeups, babbitted and bronze, are featured in 16-p booklet 2707. Descriptions of each type of block, takeup and class of application are given. Link-Belt Co

179 **Belt selection guide** for variable-speed-belt users gives sizes and engineering data, alphabetical listing of applications. 32-p catalog VSB-1 also supplies ratings and variable-speed cross-reference tables. Maurey Mfg Corp

180 **V-belt drive** manual has 68-pp, includes data for design of multiple-V-belt drives with high hp rating. Uses new standard V-belt code designation system. Contains photos, drawings, chart, tables and other engineering data covering selection and design of models from ½ to 1000 hp. R & J Dick Company, Inc

181 **Synchronous motors** with 72-rpm shaft speed without gears are topic of 12-p bulletin SS459. Price list, specs included. Superior Electric Company

continued

For more facts circle 258 on Reader Service card, p 101

STRONGER and SAFER for every high pressure pipeline duty...

...because they are drop forged by Vogt

Constantly imitated but never duplicated, Vogt forged steel fittings and flanges have unmatched strength and toughness for your most severe pipeline duties. Laboratory controlled materials and Vogt's special forging techniques assure products which are always uniform in structure, fine grained, and free from porosity. Thereby the shocks and stresses imposed by high pressures and high temperatures are easily withstood, and with stubborn resistance to erosion and corrosion. Consult Catalog F-10 for our complete line of fittings and flanges.

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HENRY VOGT MACHINE CO., P.O. BOX 1918, LOUISVILLE 1, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati

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Forged Steel Valves — Petroleum Refinery and Chemical Plant Equipment — Steam Generators — Heat Exchangers — Ice Making and Refrigerating Equipment.

Vogt

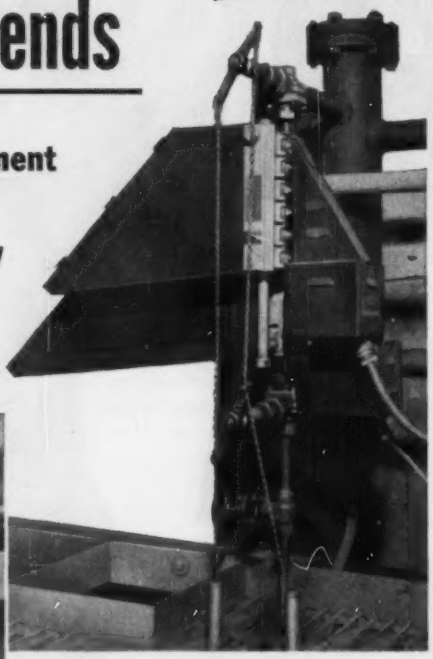
DROP FORGED STEEL

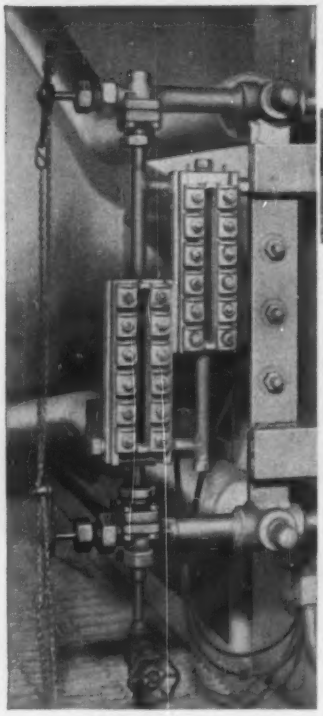
Fittings and Flanges

For more facts circle 259 on Reader Service card, p 101

Boiler Water Level Security Pays Dividends

... Reliance Equipment insures safe, sure supervision for low or high pressure plants





"Two water gages on all boilers operating at over 400 psi" says the code. Here's an example, in the municipal light and power plant of Coffeyville, Kans., illustrating modern Reliance 900 psi equipment.

Water column includes whistle alarm; is equipped with flat glass gage insert, periscope hoods to reflect image through cat-walk opening to a floor-stand mirror below; and mercury lamp illuminator for sharp, brilliant projection. The second gage, also of double-window flat glass construction, is custom-made with tie-bar, for direct-to-drum installation.

Reliance builds for all pressures — brings you a complete line of boiler safety devices. The long record of efficient, dependable service — the extra margin of safety built into all Reliance Equipment — assures long life and low maintenance. Check with your consultants or ask for nearest Reliance Representative address.

The Reliance Gauge Column Co.
5902 Carnegie Avenue • Cleveland 3, Ohio

The name that introduced safety water columns.... in 1884

Reliance®

BOILER SAFETY DEVICES

Free literature

Begins on page 101A

182 **Speed drive,** mechanical adjustable, with range up to 8:1, ratings from 1 to 30 hp ac, is described in brochure 3600. The Louis Allis Co

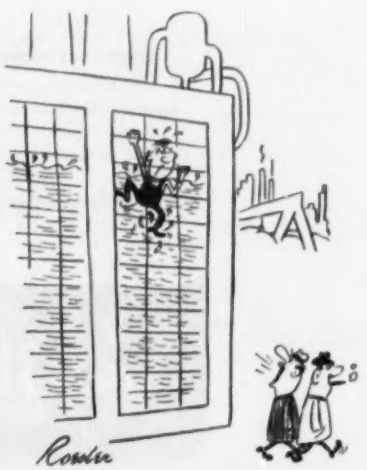
183 **Electromagnetic clutches** with torque capacities from 1.8 through 13,000 lb-ft are detailed in 20-p booklet R-6304-1B. Specs, dimensions, torque ratings, speeds and prices are given. I-T-E Circuit Breaker Co

OTHER POWER SERVICES

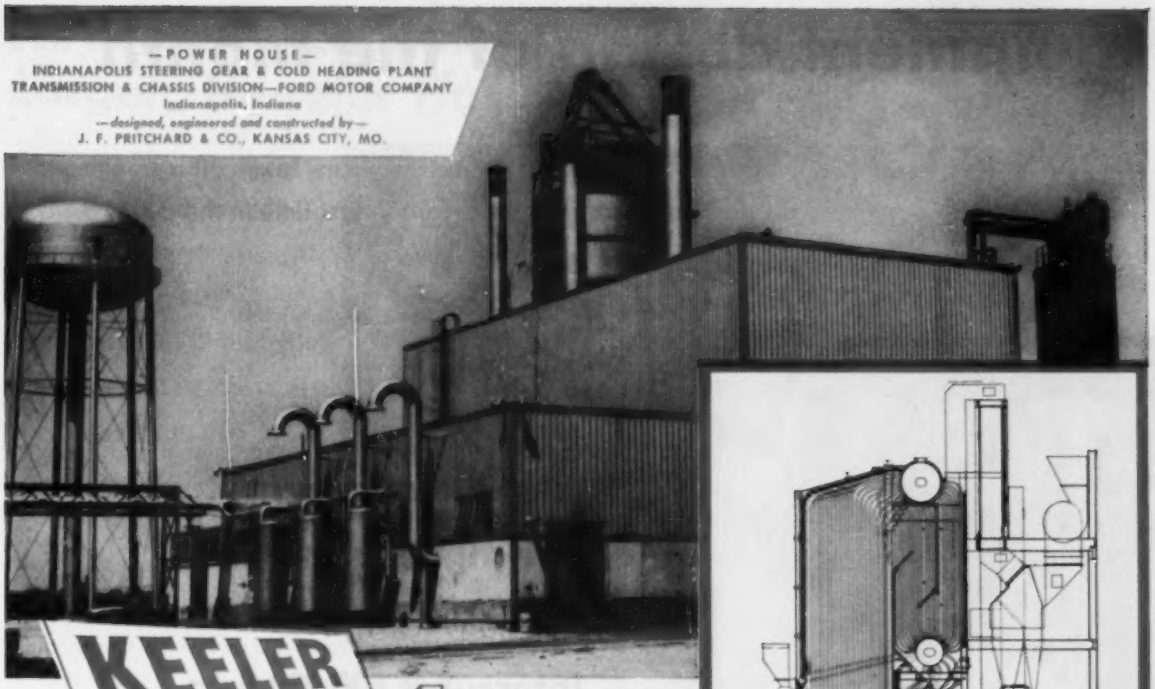
184 **Diesel-electric power houses** recently erected by West German firm are described in four languages in new pamphlet. Diesel Energy Corp

185 **Products and facilities** of firm are described in 32-p booklet. Capsule facts on power-generating, electrical-transmission and distribution equipment are given. Allis-Chalmers Mfg Co

186 **Free lube sample** is offered to readers. Metallic lubricant is said to be completely different from conventional oils and grease. Sportsmen might be interested—this lube can also be used on guns and fishing reels. Imperial Oil & Grease Company, Inc



"Hey Fitzpatrick—watch that boiler-water level!"


—POWER HOUSE—
INDIANAPOLIS STEERING GEAR & COLD HEADING PLANT
TRANSMISSION & CHASSIS DIVISION—FORD MOTOR COMPANY
Indianapolis, Indiana
—designed, engineered and constructed by—
J. F. PRITCHARD & CO., KANSAS CITY, MO.

KEELER

MK

water tube **K** *steam generators*

available in capacities from 12,000 to 200,000-lb stm/hr

95 years of design and manufacturing experience provides the basis for steam efficiency and economy at Ford plant

Three Keeler Type M K Steam Generators are serving Ford's Indianapolis Steering Gear & Cold Heading Plant with complete satisfaction on all points. They were selected for their ability to economically deliver 300,000-lb stm/hr for the plant's entire process, heat, hot water and auxiliary equipment requirements.

Two of the M K's are 120,000-lb stm/hr and the other is 60,000-lb stm/hr, 160 psi design pressure. They are equipped with air preheaters and spreader-stokers with continuous ash discharge, for bituminous coal firing—providing as modern and efficient a power facility as the manufacturing plant itself!

Keeler M K Steam Generators offer many efficiency and economy advantages! They are fully top supported, cross drum type with provision for downward expansion to eliminate any stresses being conveyed to the boiler proper, the steam piping or auxiliary equipment. Radiation losses are held to an absolute minimum with water cooled, completely steel encased and insulated furnace walls and roof.

Write or phone for complete information . . . Keeler M K's are available in capacities from 12,000 to 200,000-lb stm/hr—for high efficiency with any firing method or control system.

ONE OF THE NEWEST PLANTS in the Ford Motor Company's Transmission & Chassis Division, the Indianapolis Steering Gear & Cold Heading Plant is Ford's biggest producer of steering gear units for all company cars and trucks, and one of the largest cold heading operations in the world. The main building comprises more than 1,400,000 square feet of floor space—housing production, office and various employee facilities, including a fully staffed hospital and three cafeterias.

The Seal of Quality in Water Tube Steam Generators

KEELER WATER TUBE Boilers

— ESTABLISHED 1864 —

Write For Bulletins

No. MK-1: Type MK Boilers
No. DK-2: Type DK Package Boilers
No. F-14: Type CP Boilers
No. M-2A: Type CPM Package Boilers

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— OFFICES IN PRINCIPAL CITIES —
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For more facts circle 261 on Reader Service card, p 101

Equipment design of the month

By STEVE ELONKA
Associate Editor

On this page each month you'll see the wraps taken off a significant new product, material or process for the first time in the power field

Fused load-interrupter switchgear closes on 44,500 amp, interrupts 500,000 kva

Here's a new line of high-voltage fused load-interrupter metalclad switchgear, rated high as 44,500 amp fault closing and 500-mva short-circuit interrupting at 14.4 kv. Introduced by S & C Electric Co of Chicago, gear have corresponding ratings at 4.16 kv of 60,000 amp fault closing and 250-mva short-circuit interrupting.

Closing on 44,500-amp faults is made possible by a load interrupter with integral quick-make, quick-break device for high-speed closing. Closing action is sequenced so that circuit is made on separate arcing contacts before load-carrying contacts close.

Interrupting duty to 500 mva is provided by a new solid-material boric-acid power fuse. Multiple-bore construction lets fuse handle low, medium, and high faults. An expellable boric-acid liner automatically enlarges fuse bore to handle the heavier faults.

This switchgear offers important savings for high-voltage power distribution in industrial plants, institutions and commercial buildings. It is available in ratings from 4.8 through 14.4 kv.

Line is generally applied as switching centers and service-entrance equipment. It's available in continuous ratings of 200, 400 and 600 amp, fused. Ratings go up to 1200 amp unfused.

All requirements of the new National Electrical Code are met. This code establishes published ratings on ability to carry, to close, and to interrupt all currents up to the assigned maximum short-circuit rating of the integrated fused load interrupter and enclosure.

For additional information circle No. 77 on Reader Service card, page 101

New Nalco Coagulant makes Larger, Heavier Floc . . . Faster

Radically different Nalcolyte 110 used with Conventional Chemicals to Cut Costs, Speed Action in Water Clarification

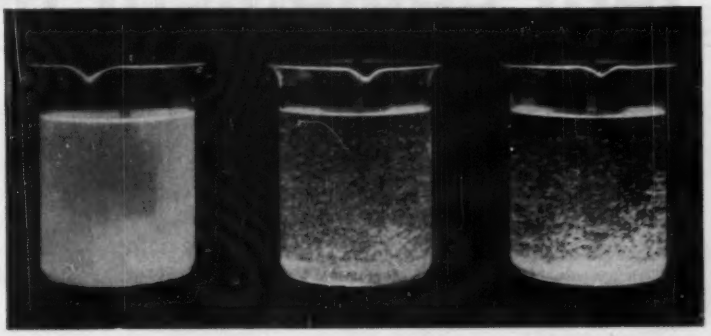

Photo taken in Nalco Laboratories 7 seconds after agitation stopped: *Left*, Control sample of untreated turbid water; *center*, same water, treated with 50 ppm alum; *right*, same water, treated with 20 ppm alum, 1 ppm Nalcolyte 110. Note that large, dense floc is settling out much more rapidly than center alum-treated sample.

Nalcolyte 110 is a new, non-ionic high polymer flocculant of very high molecular weight—over 1,000,000. It is used in extremely small dosages with conventional coagulants (such as sodium aluminate, alum, ferric sulfate) to increase size, density and uniformity of floc.

Less Chemical; Greater Capacity

Action of Nalcolyte 110 in creating heavier, larger, faster-settling floc not only permits greater throughput rates without floc carryover to processing equipment, but also cuts the total chemical requirements at a resultant cost saving.

In the example illustrated above, only 40% as much alum is required when Nalcolyte 110 is used.

May be Used in Potable Waters

Approved by the U. S. Public Health Service Technical Advisory Committee for use in treatment of public water supplies, Nalcolyte 110 gives water works the opportunity to get appreciably greater capacity from existing clarification equipment—at lower treating cost.

High Suspended Solids No Problem

Waters containing high suspended solids respond quickly to Nalcolyte 110 coagulating action . . . frequently without other coagulant chemicals.

Typical high suspended solids waters which can be treated with speed and economy with Nalcolyte 110 are paper mill white water systems, industrial waste waters, mineral slurries and blast furnace gas wash water slurries.

Nalcolyte 110 Easy to Handle

Nalcolyte 110 is a coarse, white, free-flowing powder of non-toxic character. It is fed in dilute water solutions with standard liquid proportioning pumps or feeders. Stock solutions are prepared at concentrations up to 20%. Packaging is in convenient 25-lb. bags.

Data Available Promptly

Full information on Nalcolyte 110 for your coagulant use is ready to be sent upon your request. Write today, or call your Nalco Representative.

National Aluminate Corporation is now

NALCO CHEMICAL COMPANY

6222 West 66th Place • Chicago 38, Illinois

Subsidiaries in England, Italy, Mexico, Spain, Venezuela and West Germany
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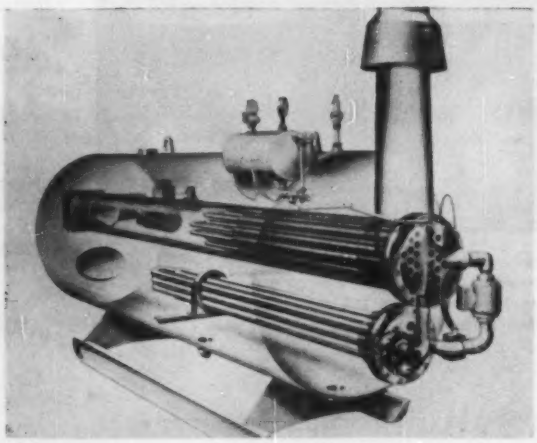
nalco® ... *Serving Industry through Practical Applied Science*

Nalco CHEMICALS

For more data on these developments, circle key numbers on Reader Service card, p 101

Plant equipment news... Your



Water heater provides scale-free heating

1 • Indirect-gas-fired storage water heater has "localized" combustion unit and fluid-to-fluid intermediate heat-transfer system for scale-free heating. Self-contained package includes electronic controls for safe, quiet and automatic operation, consists of three integrated systems: gas burner or furnace; forced-circulation heat-transfer system with firetube element, hot-water-heating bundle and interconnecting piping; shell section for heating, storing and temperature control of service water.

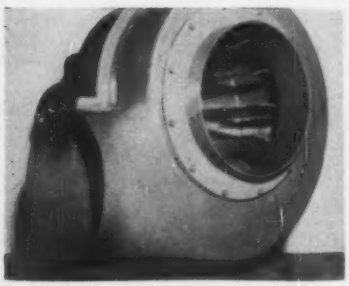
Scaling is practically eliminated, says maker, because of fluid system's delivery of heat at lower temperature and constant recirculation of heating medium. Unit works with any type of gas.—The Patterson-Kelley Co, Inc

Burner features adjustable venturi

2 • Gas-conversion burner is designed to change from oil to gas, including liquid propane. Feature is adjustable venturi which telescopes from 6½- to 13½-in. Unit fits 95% of all existing furnaces, according to manufacturer, delivers 50,000 to 225,000 Btu and is made principally from 16-gage stamped and welded steel. Burner weighs only 13 lb including safety pilot system. —Barber Manufacturing Company

Unit filters h-t fumes and dust

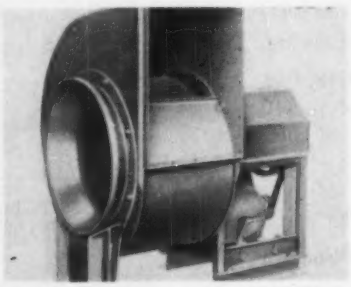
3 • This dust collector has been developed for air-pollution problems arising from h-t fume and dust emissions. Use of glass filter fabric permits filtration at temperatures up to 550 F. Jet inside each filter tube cleans dust off inside surfaces by giving off higher-pressure air alternated with reverse air flow from main fan. Tubes partially collapse, cleaning filter surfaces, and residue is deposited in hoppers.—Pangborn Corporation



Blowers resist corrosion

4 • Direct-drive corrosion-resistant utility blowers are made of unplasticized rigid polyvinyl chloride. This material resists corrosion from almost all types and combinations of fumes, says manufacturer. Blowers were designed for use where corrosive fumes or moisture are a problem.

Units are available with 1/3,- 3/4- or 1-hp motor and in capacities from 399 to 2000 cfm.—Industrial Plastic Fabricators, Incorporated



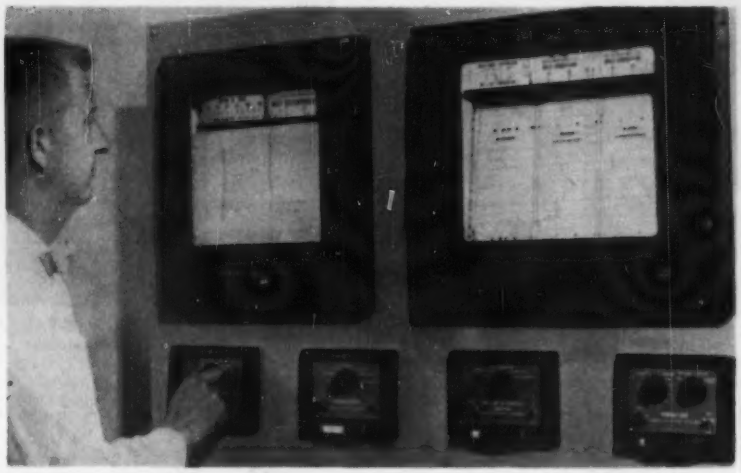
Fans integrate motor, drive

5 • Fan sets are for supply or exhaust jobs indoors or outdoors. They operate for volumes to 25,000 cfm, static pressures through 2½ in. and temperatures to 300 F, feature motor and drive integrated in one assembly. Entire drive is within the frame of the unit. According to maker, there is complete accessibility to motor, drive and bearings; motor and drive adjustment is easier; there's good motor ventilation.—Clarage Fan Co

Sampler operates at 100 cfm

6 • High air sampler collects dusts and aerosols on special filters. Filters can be analyzed when determining concentration of radioactive particles, toxic metals, dust contaminants and air pollutants. A 0.5 hp motor-driven turbine powers sampler. Unit weighs 9 lb complete with sampling head and operates at sampling rates up to 100 cfm. Normally furnished for 110 v, 50-60 cycle 220 v, unit is available for dc.—Gelman Instrument Co

information center for new products and materials

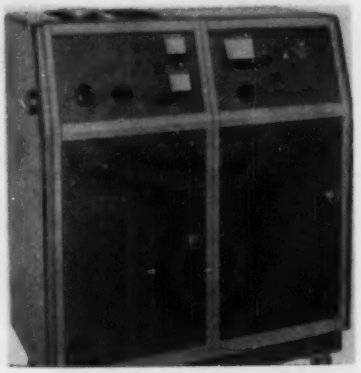


Steam-turbine supervisory system has 6-ft panel area

7 • Unit records data on two strip-chart recorders every five seconds. Size reduction of panel area is from 18 sq ft to six. Decrease in number of components has improved unit's reliability and ease of maintenance, according to manufacturer. New design eliminates need for many vacuum tubes and other components. Tubes are cut from 22 to seven. Unit will scan turbine-generator speed, valve position, shaft eccentricity, expansion, vibration. Recorders are duplex ink-writing and multipoint type.—General Electric Co

Boiler-water gage shows water level in clear contrast

8 • High-pressure boiler-water gage operates up to 3000 psi. It is designed to use principles of light refraction: water level is black, steam space shows as a brilliantly lighted line. Gage has single steel chamber with front and back ports covered with circular borosilicate glass protected by mica shield. Illuminator shines through ports, and light passing through water is refracted while light passing through steam space streams through front ports. Gage may be turned at any desired angle.—Jerguson Gage & Valve Company



Leak detector operates at 10 to 13 cu cm per sec

9 • Ultrasensitive mass-spectrometer leak detector locates and measures sizes of leaks in vacuum, pressure or hermetically sealed systems, devices or components. Unit has leak-rate sensitivity of 10 to 13 standard cu cm per sec. All components are readily accessible — even cold trap may be cleaned without shutting down.—Crosby-Teletronics Corp

Unit tests dry, liquid lubes

10 • Lubricant-testing machine can be used to test dry or liquid lubricants at ambient to high temperatures. Unit uses oscillatory or rotational motion. H-t furnace, 5-hp motor and protective electrical equipment are included.—Alpha-Molykote Corp

Gage detects small pressure differences

11 • Electrical differential-pressure gage can detect pressure differences as small as 0.0001-in. H_2O, according to manufacturer. Range is from zero to .01-in. H_2O. Operating on 115-v 60-cycle ac, sensing device is metal thermopile installed in flow tube. Unit can be used with remote recorders. It can be calibrated in terms of mass flow since instrument measures changes in temperature and pressure of air or gas.—Hastings-Raydist, Inc

Transducer measures l-p range

12 • Pressure transmitter was designed to meet needs for accurate measurements in lower-pressure ranges. High-level output signals can be delivered up to 1.5-v ac or up to 100-millivolts dc with accessory demodulator. Standard ranges available are from 0 to 1.5 psi to 0 to 60 psi with intermediate ranges and accuracies of up to ± 0.15% of full range. Operates in corrosive environments. —International Resistance Company

Rotameter boasts easy calibration

13 • Pneumatic transmitting rotameter for air signaling fluid flow rates to remote recorders and controllers has magnetic design. This provides evenly distributed magnetic field without drag on the metering float. Four calibration adjustments permit field recalibration whenever basic operating conditions change. Factor tag on dial face is used to convert scale units to flow quantity.—Schutte and Koerting Company

For more data on these developments, circle key numbers on Reader Service card, p 101

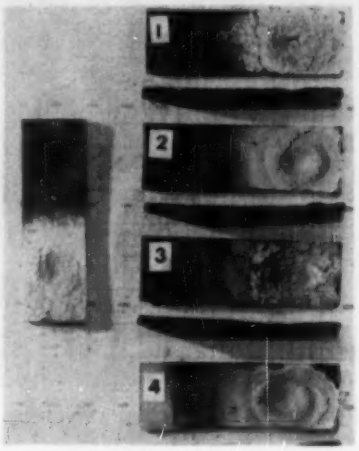
More **equipment news**

For more data on these developments, circle key numbers on Reader Service card, p 101

Plasma-flame gun sprays high-melting-point materials

14 • Spray gun utilizing the plasma-arc principle will spray any material that melts without decomposing, according to manufacturer. Normal work temperatures are 10,000 to 15,000 F.

Plasma-flame spray gun applies coatings of high-melting-point materials such as zirconium carbide (3540 F), tungsten carbide (2850 F), zirconium boride (3000 F), zirconium oxide (2700 F), niobium carbide (3900 F) and other oxides, borides and carbides. Physical and metallurgical properties include reduced porosity, good bond and tensile strengths.—Metallizing Eng Co, Inc



New plastic-ceramic material has high heat-resistant properties

15 • Resin-bonded-quartz sheet is a combination of reinforced plastics and ceramics. Finely divided particles of fused quartz are bonded together with high-temperature-resistant Pyropreg resin. Small percentage of glass or other fibers is included to give material good handling properties, says maker. Firm recommends using this as a facing on a laminate of Pyropreg-reinforced plastic.

Fused-quartz particles have low coefficient of thermal expansion. When melted, resultant liquid acts as insulator for unmelted material. Pictured above are five panels tested at 5500 F.—Cordo Chemical Corp

Sakaphen now available to American market

16 • Protective-coating formula based on synthetic resins is said to withstand influence of acids and alkalis at saturated temperatures up to 300 F. First developed by a German engineer, Sakaphen is now available to the American market. According to manufacturer, resistance to dew-point corrosion is excellent. Protection for such metal and concrete surfaces as chimneys, precipitators is suggested application.—American Sakaphen Corporation

New spraying outfit is used for Freon-TF solvent

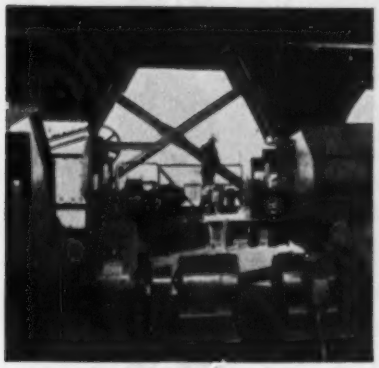
17 • Nontoxic, nonflammable and nonexplosive fluid can clean electric motors in place. New spraying outfit for delivering Freon-TF consists of air-operated pump mounted directly on unpressurized material drum. Pump speed is controlled by air-adjustment valve. Space design of unit prevents fluid from entering air motor. Pump needs no oiling or lubrication. Maximum air requirements are 3 to 6 cfm. Solvent is delivered on up and down strokes.—Binks Mfg Co

Non-acid chemical de-activates scale

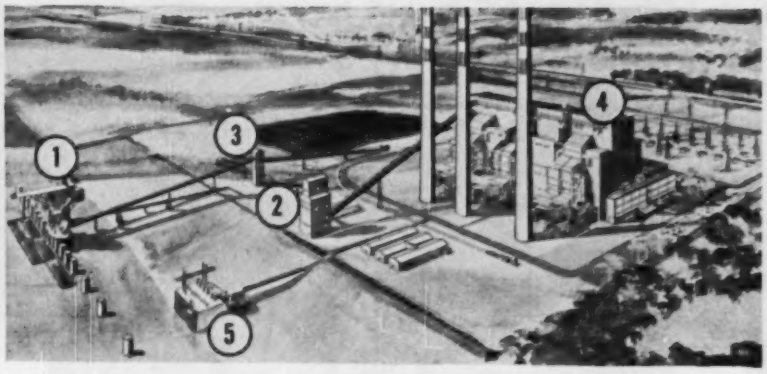
18 • Organic chemical which is practically odorless, nontoxic, nonflammable and noncorrosive for use as de-scaler and scale inhibitor is now in production. Aidco 10 economically de-activates scale on boilers, heat exchangers, condensers, pipelines and refrigeration coils, according to maker. The pH of Aidco 10 is between 9 and 11 and sp gr is 1.14. One gal of formula is added to six gal water and circulated at 160 to 180 F.—Alloy Industries Development Co

For more data on these developments, circle key numbers on Reader Service card, p 101

Directing traffic for 2200 tph



1. BARGE UNLOADING—Coal reclaimed by belt feeders is fed to two belt conveyors delivering to transfer tower where it may be directed to outside storage or bunkers.



LINK-BELT coal handling system adds to efficiency of Thos. H. Allen generating station at Memphis

At this new and highly efficient Memphis power station, designed by Burns and Roe, Inc., coal is carried from barge to storage to bunkers at capacities up to 2200 tons per hour. The entire system of Link-Belt coal handling conveyors is operated by one man from a central control panel.

This huge Link-Belt coal handling network is a product of more than 80 years' experience. Before the advent of commercial electricity, Link-Belt was already establishing a reputation for efficient coal handling equipment in steam generating plants.

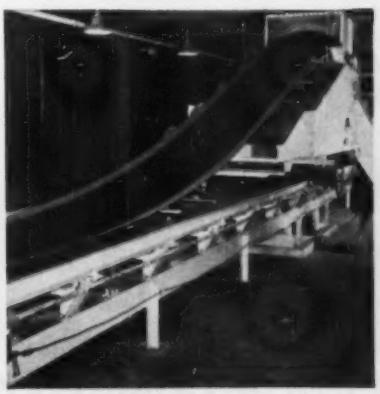
Today Link-Belt serves as a single source and responsibility for complete coal conveying systems or components . . . for both central stations and boiler houses. For details, write to Link-Belt Company, Dept. AV, Prudential Plaza, Chicago 1, Ill. Ask for Book 2410. It shows the latest in layouts and equipment for power plants, large and small.

2. COAL CONVEYING—Two Link-Belt 48-in. wide inclined belt conveyors route coal to crusher. Each has a capacity of 1100 tph at speeds of 485 fpm.

LINK-BELT

One source . . . one responsibility for materials handling, processing and power transmission equipment 15,173

3. STOCKPILING is accomplished by the Link-Belt movable and stationary stackers. Both are equipped with Link-Belt 60-in. wide conveyor belts.



4. BUNKER LOADING—Two Link-Belt 48-in. bunker conveyors are equipped with trippers to distribute coal to bunkers at the rate of 1100 tons per hour.

5. SCREENING—Link-Belt bar screen in water intake pump house protects pumps and other equipment from debris, cleans water for condenser cooling.

Your *FISHER/MAN* offers you

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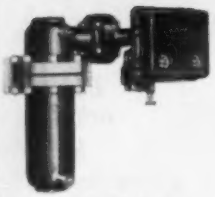
Type 657-A with 3500 positioner

Type 4150 and 4160 Wizard II Pressure Controllers



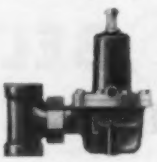
Series 2500-249 and 2500-259B Level-Trols

Type 95-H Pressure Reducing Valve

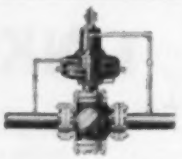
Type 630 "Big Joe" Field Regulator

Series 99 Multi-Purpose Gas Regulators

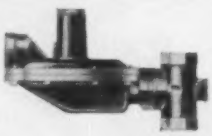
Type 655-A Pressure Regulator



Series 620 and 621 Farm Tap Regulators

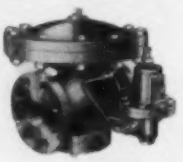


Series 298T Gas Regulators



Series S100 and 730 Service Regulators

Series 67FR Combination Filter-Regulator



Type 92B Pilot Operated Steam Reducing Valve

This "supermarket" availability of Fisher Control Valves and Controllers makes your delivery problems a thing of the past. Fisher keeps a stock of the equipment at left always on hand ready to ship to you at hourly notice. This means emergency requirements are met without costly delivery delays. This stock of control equipment includes all the most popular types in standard sizes.

In addition to the large factory stock, the Fisher offices in the column to the right which are starred carry a big selection of Fisher equipment in inventory to assist you.

Fisher constantly reviews the stock carried in the Supermarket and adds new items from time to time when your needs indicate.

Phone, wire or TWX (Marshalltown 578 or 579) and Fisher will have your order en route in a matter of hours, Saturday and Sunday excepted.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD...CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

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*CALGARY-EDMONTON
Barber Engineering & Supply Company
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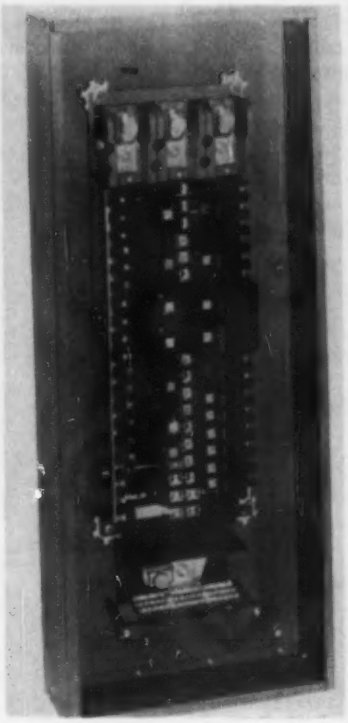
Equipment news

Begins on page 112



Load center

43 • Double-bus design increasing circuit capacity makes this unit available for industrial use. Four rows of breaker plug-in slots permit mounting of 100 amp breakers opposite each other. One inch increase in panel width doubles capacity for 100 amp circuits. Power panel applications up to 400 amp mains, 240 volts and branches of 100 amp can be met.—Federal Pacific Electric Company

Just circle key numbers on the Reader Service card, page 101, to get complete product story

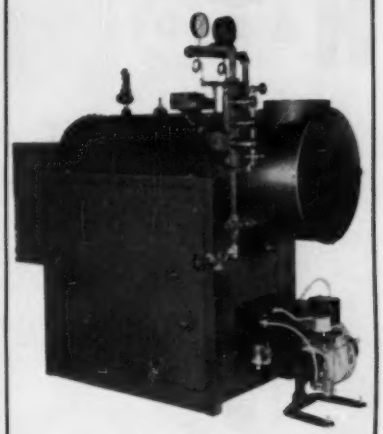
Electrical insulation

41 • Insulation can simply be painted or sprayed on electrical equipment subject to high-voltage discharges. It dries to form a smooth painted surface and at the same time is said to give standard insulating materials resistance to breakdown by electrical arcing or "tracking".

Maker describes product as an

JOHNSON

HORIZONTAL STEAM GENERATOR



- **Fuel—Gas, Oil or Combination Gas and Oil Firing.**
- **Design—Modern, Efficient.**
- **Construction—A. S. M. E. Standards.**
- **Inspection — Fully tested under the most rigid conditions.**
- **Standard Pressure—100 lbs.**
- **Extra High Pressure—up to 250 lbs.**
- **Easy Adaptability — to boiler feed and return condensate units.**

The Johnson Horizontal Steam Generator comes in four sizes to suit your needs, 6½ H.P., 15 H.P., 25 H.P., and 33 H.P. Extra high pressure if desired up to 250 lbs. For complete specifications and details write today for our fully illustrated Bulletin No. 8-C.

"Engineered Steam at its best, with over 51 years of experience at your disposal"

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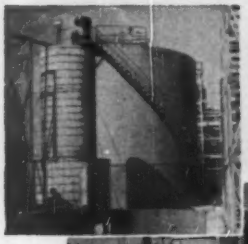
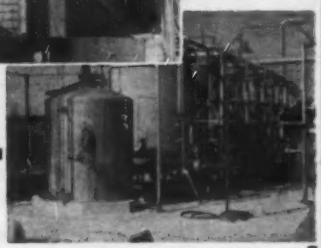
WHO CHOSE H&T?

For Boiler Feedwater Conditioning Equipment



400,000 lb. per hour fully automatic demineralizer plant with silica and CO_2 removal



These Fine Companies Did!

A Partial List of Installations

Duquesne Light Co.
Shippingport, Pa.

Yankee Atomic Electric Plant
Rowe, Mass.

Ohio-Edison Co.
Akron, Ohio

Bowaters-Carolina Corp.
Catawba, S.C.

Knolls Atomic Power Laboratory
West Milton, N. Y.

The Cleveland Elec. Illuminating Co.
Ashtabula, Ohio

Chevrolet Div. Gen. Motors Corp.
Tarrytown, N. Y.

R. J. Reynolds Tobacco Co.
Stokes County, N. C.

Tampa Electric Co.
Tampa, Florida

U. S. Gypsum Co.
Chicago, Ill.

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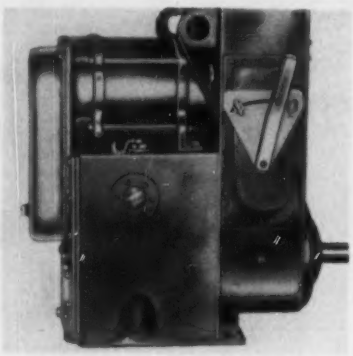
50 Years of Progress

HUNGERFORD & TERRY, Inc.
CLAYTON 3 — NEW JERSEY
H&T SERVICE

Equipment news

Begins on page 112

epoxy type resin. The epoxies claim stability, resistance to moisture absorption and ability to adhere to almost anything; the adhesive properties of such resins are responsible for close bonding this insulation has to various kinds of existing insulating surfaces. — Westinghouse Electric Company



Hydraulic transmission

22 • 1½-hp unit has variable speed from 0 to 350 rpm in either direction. Forward and reverse speeds can be set identical or different. According to manufacturer, reversing is instantaneous. Motor with rolling-contact bearings is available for either single- or 3-phase supply. Unit is suited for heavy-duty applications. —Roberts Manufacturing Company

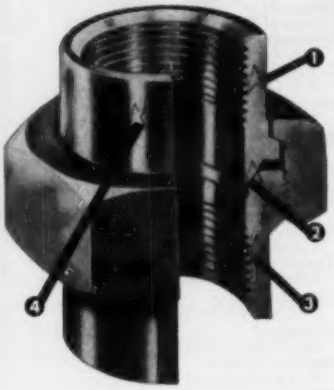
Just circle key numbers on the Reader Service card, page 101, to get complete product story

Pipe suspension system

38 • System is geared to piping needs of the heating-plumbing-air conditioning industry. Metal framing line consists of preformed channel for structure of racks and framing fittings to connect channel pieces into desired framework. Pipe hangers support the system. Changes or expansion can be made with a minimum of expense, says maker. All you need for installation are saw and wrench.—Fee & Mason Manufacturing Company

continued

only
CATAWISSA
gives you all these features for your forged steel pipe union requirements



1. **Uniform walls** for even expansion and contraction under temperature changes. They follow the pipe!

2. **Catawissa Ball-to-Angle Seats** give you a "Perfect Seal" regardless of pipe alignment!

3. **More than adequate** wall thicknesses give you Catawissa's 3-to-1 Safety Factor (3000-lb. service, 9000-lb. test; 6000-lb. service, 18000-lb. test)!

4. **Round, straight barrels** for fast wrenching. No uneven or tapered surfaces to cause wrench slips or wrench locking!

Catawissa Perfect Seal Pipe Unions are made by Union Specialists from 80,000 lb. tensile strength steel (ASTM Spec. A-105-55T, Grade II). Steel forgings from our own forging mill are closely checked for imperfections . . . and finishing on modern, automatic machines with close inspection during and after production give you pipe unions second to none!

Write for Catalog 58 showing the complete Catawissa line of Perfect Seal Products.

for complete, guaranteed satisfaction

. . . always specify
CATAWISSA

CATAWISSA VALVE & FITTINGS CO.
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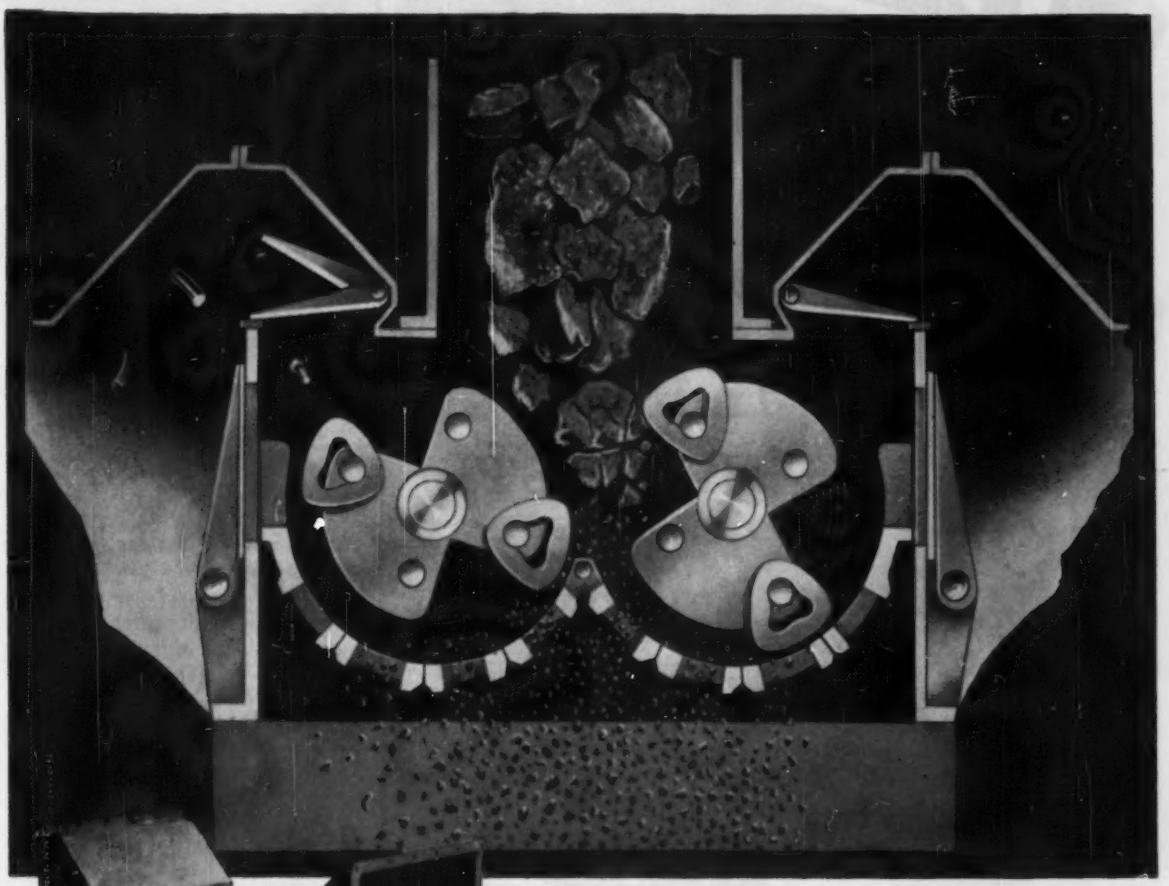
circle 266 on Reader Service card, p 101

circle 267 on Reader Service card, p 101

STEPHENS-ADAMSON

KNITTEL CRUSHER Ring Type with Double Rotor



Double Rotor Knittel Crusher with ring type double rotor.

DOUBLE ROTORS BLAST LUMPS TO SIZE WITHOUT DANGER OF PLUGGING

- EXCLUSIVE CRUSHING ACTION . . . Permits the material to fall further into the crusher where two sets of triangular sectors can take a high velocity direct blow on the suspended lumps. Lumps are not only shattered but are literally gobbled up in a continuous flowing stream to the sizing grates.
- CRUSHES DAMP MATERIALS with FULL CAPACITY . . . Eliminates the use of stationary breaker plates, as a result there is no plugging or choking and full capacity is maintained.
- LESS HEADROOM — LESS POWER REQUIRED . . . Requiring considerably less headroom and less power than with single rotor machines.
- TRIANGULAR SECTORS . . . Three wearing surfaces of manganese steel triangular sectors automatically position themselves to present the least worn surface to the crushing action.
- GRATE SIZING BARS . . . Provide accurate sizing of materials, prevent uncrushable materials from passing.
- AUTOMATIC TRAMP IRON RELEASE . . . Steel fingers, operating independently, automatically lift to pass uncrushable material.

WRITE FOR BULLETIN 858

S-A

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SPEEDWALK® PASSENGER CONVEYORS

SPEEDECO® LOADERS & BOOM ENDS

ENGINEERING DIVISION

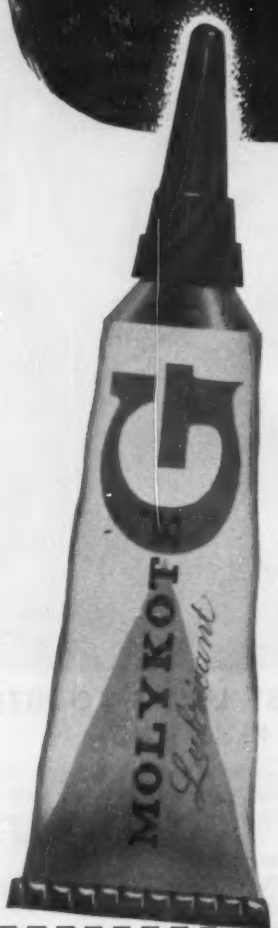
STEPHENS-ADAMSON MFG. CO.

GENERAL OFFICE & MAIN PLANT, 5 RIDGEWAY AVENUE, AURORA, ILLINOIS

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

For more facts circle 268 on Reader Service card, p 101

Free! Sample Tube of MOLYKOTE® G LUBRICANT



Industry's NEWEST Production TOOL

- ALMOST 100% SAFETY AGAINST GALLING AND SEIZING WITH ALL BEARING METAL COMBINATIONS
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- REDUCES WEAR-IN TIME AND DAMAGE IN NEW OR REBUILT MACHINERY
- THE HIGHER THE LOADS, THE GREATER THE MARGIN OF SUPERIORITY OF MOLYKOTE G

Write for your free sample of MOLYKOTE G LUBRICANT today. We will also send you a copy of our new Bulletin 126 which gives complete details. THE ALPHA-MOLYKOTE CORPORATION, 65 Harvard Avenue, Stamford, Conn. Phone FIreside 8-3724. Plants in Stamford, Conn., Munich, Germany and Strasbourg, France.

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MOLYKOTE G
LUBRICANT

Equipment news

Begins on page 112

Cleaning gun

33 • Pocket-sized needle gun meets requirements of cleaning, de-scaling and de-rusting jobs, particularly in small and confined places. Lightweight gun is air-operated. It consumes maximum of only 4.8 cu ft air per min. Weight is 3.3 lb.—The Marindus Company, Inc

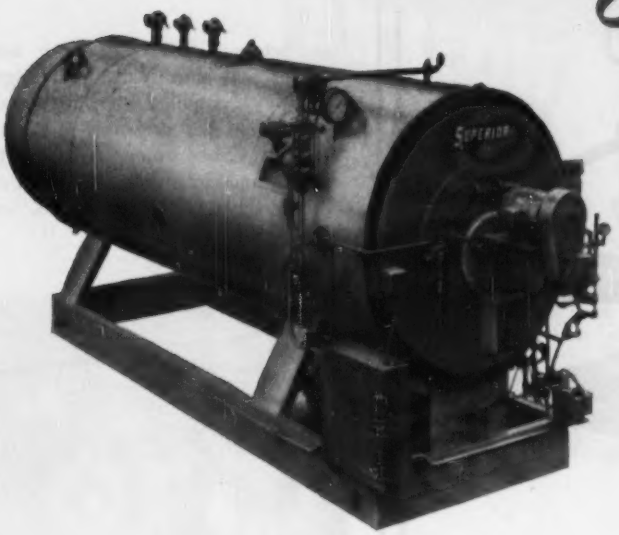
Circuit breaker

49 • Low-impedance high-shock circuit breaker with 5- to 75-amp rating features inverse time delay action. For use in electronic applications, unit has thermal bi-metal and independent magnetic trip element and is available with or without auxiliary switch.—General Electric Co

Just circle key numbers on the Reader Service card, page 101, to get complete product story

Pressure reducing valve

39 • External pilot-operated steam pressure reducing valve meets all requirements for most steam pressure reducing valve installations, says maker. Valve includes stainless-steel-ball inner valve closing against a monel-seat ring to withstand wire-drawing effects of steam. Flow of steam is streamlined by tapered open-



This is the PACKAGED BOILER

that meets ***ALL*** *the "specs"*

BOILER SPECIFICATIONS

- Undivided responsibility ✓
- 5 sq. ft. of heating surface per boiler horsepower ✓
- Built-in induced draft ✓
- 4-pass, down-draft design ✓
- Burn oil or gas, or both ✓
- Fully automatic operation ✓
- Dependable rotary burner ✓
- Insulated and jacketed ✓
- 80% thermal efficiency guaranteed ✓
- Factory-fire-tested ✓

Many packaged boilers will meet some of the specifications listed here. Superior Packaged Boilers meet them ALL. Today, more and more packaged boilers are being purchased on the specifications of architects and consulting engineers. Those consulting engineers are demanding that packaged boilers "measure up" to design and performance standards which assure buyers both operating economy and long-lived dependability.

Superior Packaged Boilers . . . built to the highest standards in the industry . . . meet the most exacting "specs", and usually exceed them. That is why Superior Packaged Boilers are so often recommended and so quickly approved by experienced consulting engineers.

In addition to the Type C, illustrated, Superior manufactures both fire-tube and water-tube boilers in a wide range of sizes which makes it the most complete line of fully packaged boilers available. If you will indicate the capacity in which you are interested, we will be happy to assist in the unbiased selection of boiler equipment suited to your specific operations.

Write today for bulletin 11C.

Specialists in PACKAGED BOILERS . . . exclusively

SUPERIOR COMBUSTION INDUSTRIES, INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
PACKAGED BOILERS

For more facts circle 270 on Reader Service card, p 101

MEG® TYPE

OF

MEGGER

(Reg. U. S. Patent Office)

Rectifier-Operated

INSULATION TESTERS

For repetitive insulation resistance tests on a production basis . . . and for time-resistance tests . . . nothing equals the Meg Type Rectifier-Operated Insulation Tester for convenience and reliability. The plug-in rectifier source of power permits the instrument to be used without hand cranking. A constant-voltage feature reduces pointer fluctuations which may occur when testing equipment having appreciable capacitance, such as larger generators and long cables. Standard units are available for 500 or 1000 volts d-c test potential and for ranges up to 2000 megohms.

Other Megger Insulation Testers include hand-crank models and Dual-Operated sets. The latter are versatile instruments with rectifier for repetitive or time-testing that can be disconnected for hand-crank operation in the field.

Write for BULLETIN 21-46-P

BIDDLE IMPULSE CABLE FAULT LOCATING EQUIPMENT

. . . for locating cable faults by impulse tracer method . . . for D-C proof testing. Applicable to aerial and buried cable as well as lead-covered cable in ducts. Transmitter can be connected to 115 V, 60 cps supply.

MODEL 3-2—Output voltage up to 25 kv. Discharge capacitance 1.65 muf. For use on cable up to 15 kv rating.

MODEL 4-2—Output voltage up to 15 kv. Discharge capacitance 2 muf. For use on cable up to 5 kv rating.

MODEL 5-2—Output voltage up to 5 kv. Discharge capacitance 16 muf. For use on cable up to 1 kv rating.

Write for BULLETIN 65-P

JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

Equipment news

Begins on page 112

ing between ball-inner valve and beveled seat ring. Valve diaphragm is made of stainless steel to permit use with higher pressures and temperatures. Sizes range from ¾ to 4-in. Comes in bronze, semi-steel or cast steel body.—Klipfel Valves, Inc

Outdoor switchgear housing

40 • Housing is made of extruded-aluminum panels which are snapped together to provide a maintenance-free structure for outdoor use, says maker. Surfaces require no primers, enamels, sealers, or periodic repaintings. Snap-tight interlocking panel edges are said to form permanent, leak-proof joint. Light weight and modular construction speed handling and installation. Housings are available in all sizes and voltage classes.—Allis-Chalmers Manufacturing Company

Just circle key numbers on the Reader Service card, page 101, to get complete product story

Conveyor holdback

32 • Holdback is designed to protect workers and equipment from dangerous reversal of conveyors and elevators. With installation of unit on the head shaft, conveyor or elevator can be stopped at any time without danger of load traveling backward, says maker. When power is interrupted or when load makes slightest move backwards, rollers wedge between drum and wedge-

ANKLON THREAD SEAL®

Makes Pipe-Doping Clean, Quick and Easy!

Here's the modern pipe-thread sealant that does away with messy cans, bottles and brushes—assures clean, neat work in record time—while giving joints lasting protection against corrosion of acids, gases and solvents.

Made of DuPont's TEFLON,* Anklon Thread Seal is permanently self-lubricating, will not deteriorate . . . retains its flexibility. You will like the greater ease of assembly—*and disassembly, even after a long time!* Anklon Thread Seal is economical, too: One 520" roll will dope up to 200 one-inch pipe joints.

Features and Specifications

Easy to Carry: Flat ½" roll contains 520". Other sizes on special order.
Only One Wrap-Around Needed for Many Pipe Sizes.
Effective at Temperatures from −450°F. to +500°F.
Chemically Inert—Protects Joints from Corrosion.
Will Not Cause Contamination.

*DuPont's trademark for its TFE-fluorocarbon resin

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FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

For more facts circle 272 on Reader Service card, p 101

For MOST ECONOMICAL Cost-Per-Ton SERVICE

Use *Webster*

Series 32 IDLERS

Quality-designed and quality-controlled for perfect and permanent roll alignment, economical operation, and minimum maintenance. Your coal-handling system can be improved with these WEBSTER features:

- **Heavy malleable iron roll ends provide rigid, perfectly aligned seats for the bearings.**
- **Strong inner steel tube connects the roll ends and provides grease reservoir for bearings.**
- **Rounded edges of the balanced steel rolls lock in the cast ends and protect the belt.**
- **Timken tapered roller bearings are oversize to meet overloading and constant operation.**
- **Labyrinth seals of metal and felt keep grease in and dirt out.**
- **Rolls easily removed. All parts interchangeable.**
- **Rigid malleable iron supporting brackets.**

You will be pleased with WEBSTER engineering and product service. Let us know your requirements.

Webster **MANUFACTURING, INC.**

DEPT. P-10, TIFFIN, OHIO

BULK MATERIALS HANDLING EQUIPMENT

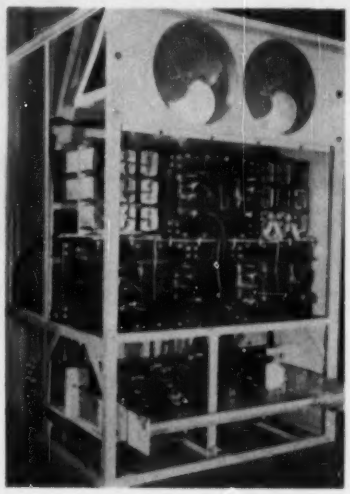
SINCE WM 1876

Offices in All Principal Cities

Equipment news

Begins on page 112

plate preventing reversal without appreciable shock.—Stephens-Adamson Manufacturing Company



Dc power supply

24 • 3000-amp dc power supply for vacuum and pressure melting furnaces features saturable reactor control of output and silicon rectifiers. This can be used to parallel a power supply of same or dissimilar current ratings. According to maker, unit utilizes silicon rectifiers throughout and thus has efficiency of 87%. Air or water-cooled models are available. —A O Smith Corp, Welding Products Div

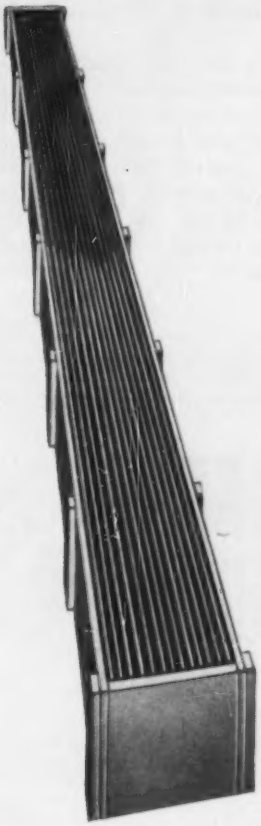
Just circle key numbers on the Reader Service card, page 101, to get complete product story

Drip-proof motors

42 • Motors are said to operate under adverse conditions of excessive moisture, high humidity and temperature, dust, oil and chemically contaminated atmospheres. Silicon sealing compound provides flexible insulation which is thin and nonporous yet resilient. Rotor and fan are sprayed with anti-corrosion coating. Available in ratings from ½- to 50-hp, any phase, frequency or voltage. —Sterling Electric Motors

continued

POWER PEOPLE Should Buy WOLVERINE TUBE



BECAUSE

Wolverine specializes in tubing — directs all of its research, development and manufacturing facilities into the production of one type of product—tubing. The result is a manufacturing program with but one objective—to produce the finest tubing possible.

BECAUSE

Every Wolverine condenser and heat exchanger tube receives a mechanical expansion test to insure that it will stand up under the toughest operating conditions. This rigid preshipment inspection saves time and labor for your inspectors—whether they are in our plant or yours. These tests are in addition to the statistical quality control that is carried on during the entire manufacturing process.

BECAUSE

At its headquarters in Allen Park, Michigan, Wolverine Tube maintains the tubing industry's most complete research and development facilities. Here, continuous research is carried on to insure that Wolverine customers not only get the finest tubing available today but also the newest trends in tubing technology—as they occur.

These are but some of the reasons why you should specify Wolverine prime surface condenser and heat exchanger tubing. You'll find more in Wolverine's Tubemanship Book. Write for your copy today. And remember, "Men Who Know Tube, Know The Difference—TUBEMANSHIP."

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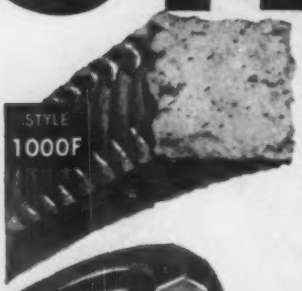
Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

J-6256

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

For more facts circle 274 on Reader Service card, p 101

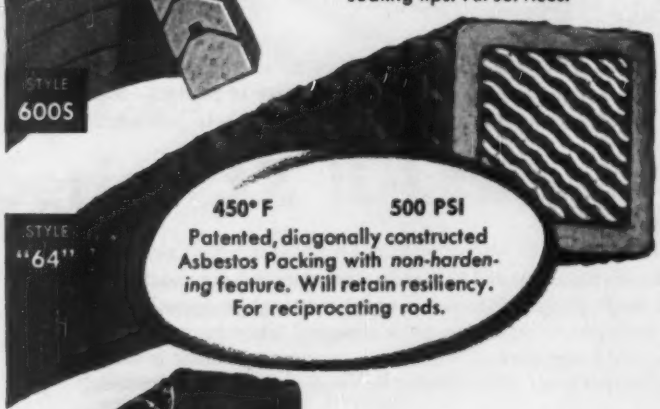
5 CHESTERTON PACKINGS expressly developed for STEAM



HEAT . . . . . PRESSURE

1000°F 2000 PSI
A 95% pure asbestos braided yarn with monel wire insertion. Mica lubricated. For extreme heat and pressure service.

550°F 1000 PSI
Improved self-sealing moulded Asbestos Packing with multiple feather sealing lips. All services.



450°F 500 PSI
Patented, diagonally constructed Asbestos Packing with *non-hardening* feature. Will retain resiliency. For reciprocating rods.

350°F 125 PSI
Soft, highly lubricated Asbestos Packing for medium to low pressure and fast moving shafts.

750°F 1000 PSI
Compressed Asbestos Sheet. Homogeneously constructed with complete graphite impregnation. Cuts easily. *"Lasts as long as the iron."*

Send for new brochure.

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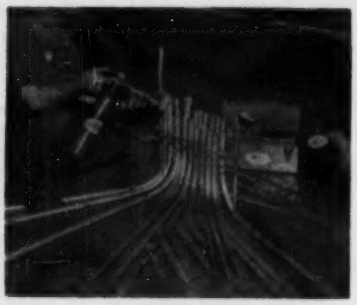
SERVICE

A. W. CHESTERTON CO., 7 ASHLAND ST., EVERETT 49, MASS.
America's Oldest Manufacturer of Mechanical Packings

Equipment news

Begins on page 112



Gas-driven conduit snake

29 • Unit is designed to save time by eliminating need for snaking wires through ½- and ¾-in. conduit with metal tape. Expansion of a harmless gas propels lightweight line package through conduit. Nylon line is then used to pull polyethylene rope and wire through pipe.—Jet Line Gun Company

Just circle key numbers on the Reader Service card, page 101, to get complete product story

Fuse-breaker

44 • 600-v coordinated fuse-breaker unit includes low-voltage power circuit breaker and current-limiting fuses. Primary application is for service entrance and feeder protection where high fault current exists. Rating is up to 1600-amp continuous and 200,000-amp interrupting capacity. Available with either manual or electrical operation.—Federal Pacific Electric Company

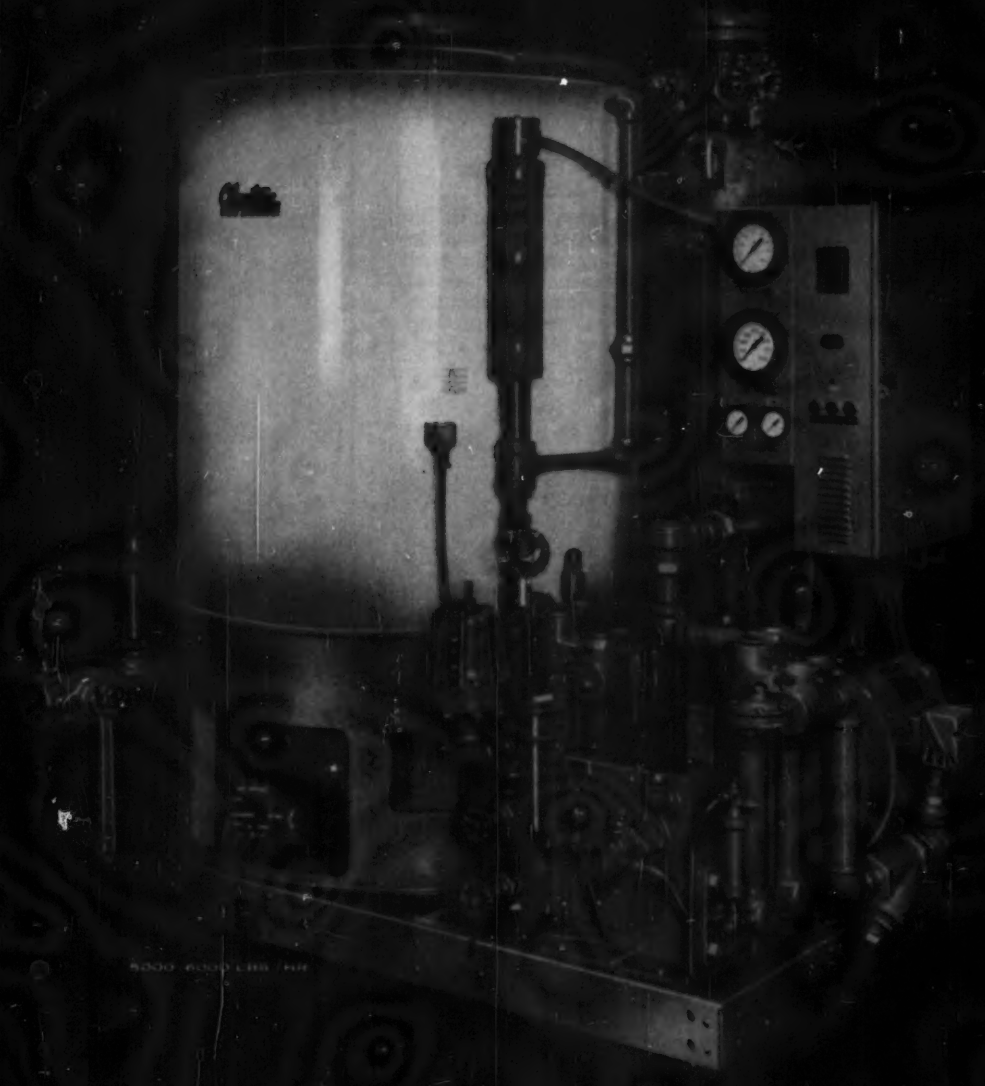
Sealed roller bearing

23 • Unit is recommended for use in high load applications in abrasive environments. Feature is buna-N, steel-backed, rubber-bonded seal that is said to prevent dirt, dust and chaff

For more facts circle 275 on Reader Service card, p 101

circle 276 on Reader Service card, p 101 ➤

STEAM THE MODERN WAY



CLAYTON STEAM GENERATORS

Up in performance—Down in size

•Sizes from 10 to 125 HP • All sizes 65 to 195 psi • Larger sizes 15 to 295 psi • Gas, light or heavy oil, or in combination • Requires no more space than an ordinary conference table

Clayton

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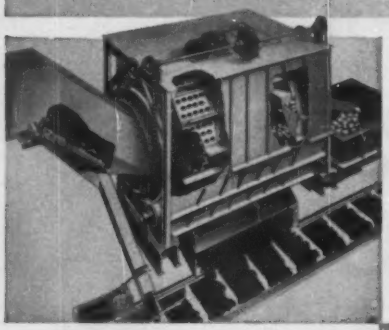
More and more utilities now use this

Rugged Cost Cutting Coal Processing Equipment

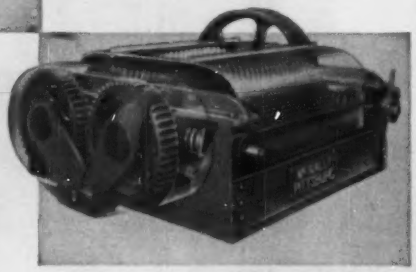


McNally Pittsburg Rotary Breaker

This heavy-duty unit allows positive control of top size in handling run-of-mine washery feed. Production of fines is held to a minimum. Without center shaft or spoke interference, costly maintenance is usually drastically reduced.

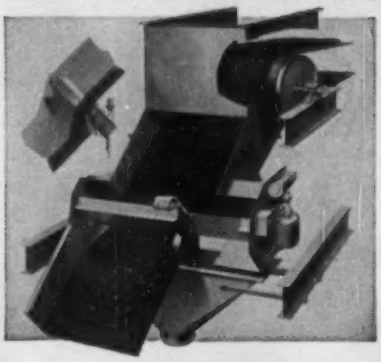
Gearmatic Stoker Coal Crusher

Built to handle heavy coal tonnages, these crushers have proved most efficient to reduce 8" minus to stoker grades. They offer three major advantages: 1) high volume production; 2) accurate sizing; 3) low percentage of fines.



McNally Pittsburg Primary Coal Sampler

This automatic sampler (adjustable from 1 to 30 minutes) cuts out true samples of the coal stream. Cutter opening permits largest particle of stream to pass freely into cutter. Conveyor discharges into chute in which sampler is installed.



Ask the men who know coal from the ground up!

Your McNally Pittsburg man offers more than 37 years of experience in the preparation of coal. He can save *you* time and money in the selection of equipment to do your job more efficiently. *Write today!*

McNALLY PITTSBURG

MANUFACTURERS OF EQUIPMENT TO MAKE COAL A BETTER FUEL

McNally Pittsburg Mfg. Corp.
Dept. P, Pittsburg, Kansas
Gentlemen: Send me more information on these products:
☐ Rotary Breaker ☐ Coal Crusher ☐ Primary Coal Sampler

Name_____ Title_____

Company_____

Address_____

City_____ State_____

from abrasive action on rollers and races. Sealed bearing has capacity of 13,400 lb.—Rollaway Bearing Company, Inc

Hose rack extinguishers

26 • Pressurized dry-chemical hose rack extinguishers can be used on flammable liquid, gas and electrical fires. 200 and 400 lb units can be floor, wall or truck mounted. Nozzle discharges for a range of 40 ft. Hose lengths of 50 or 100 ft are available. —Walter Kidde & Co, Inc

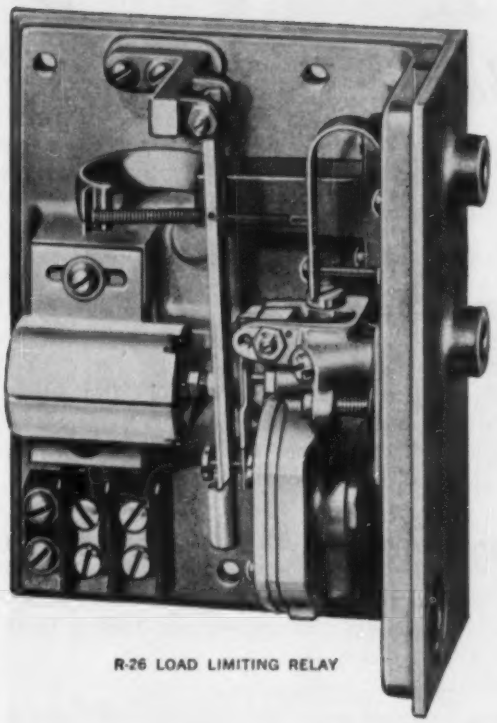
Just circle key numbers on the Reader Service card, page 101, to get complete product story

Diaphragm pumps

25 • Units are designed especially for high-solid-content-water handling and for positive control of seepage. Sizes range from 1½- to 4-in. Centrifugal pumps are mounted on wheels for easy handling in cramped quarters, says maker. Models are available with gasoline engine or electric-motor drive.—Hale Fire Pump Company

NEW JOHNSON R-26 LOAD LIMITING RELAY

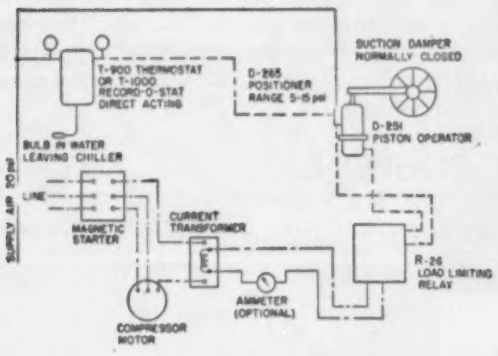
FOR POSITIVE PROTECTION AGAINST MOTOR OVERLOADING



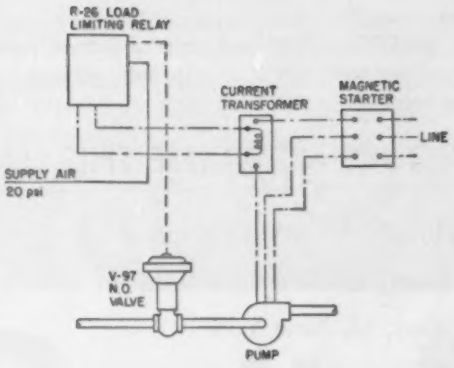
R-26 LOAD LIMITING RELAY

- A superior new limiting device for use with pneumatic control systems. Designed for application to all makes of centrifugal refrigeration compressors and to pumps, fans, and electric heating systems.
- Provides positive, efficient protection against motor overloading. Prevents failures and damage to valuable equipment.
- Operates at any current value between 3 and 7 amperes. With proper transformer, can be applied to motors of any size. Single adjustment determines maximum current input.
- Fast, highly accurate response. Pneumatic feedback element assures maximum stability and performance.
- Simple, trouble-free. No maintenance problems.

For full information, write for Bulletin R-26. Johnson Service Company, Milwaukee 1, Wis.



Load Limiting Relay used with piston operator for overload protection of centrifugal refrigeration compressor.



Load Limiting Relay applied to pump installation.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

OUR 75TH YEAR

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

For more facts circle 278 on Reader Service card, p 101

What is hard surfacing good for?
What is energy?
How can I eliminate air pollution?
Is proper coal handling the answer to my problem?
What's new in electrical operation?
What are the profit opportunities in the power services?
How can I stop corrosion in my plant?
Are my belts operating properly?

ALL THE ANSWERS ARE HERE . . .

1. Energy—You will thrill when you read this presentation explaining the most basic force operating today. Vivid drawings, clear concise text, make this subject fascinating reading. You will want to order more, to show to your engineering associates, to give to students. Don't miss this one. Only $1.00 per copy.

2. Today's Electrical Practice—A complete rundown on today's industrial electrical practice. Covers early planning for an electrical system, setting up your plant's power supply, carrying electricity to the job and putting electricity to work. 32 pages colorfully illustrated—Price $1.00 per copy.

3. Fuel Handling & Storage—Methods & Equipment for receiving, unloading, storing, measuring and handling fuels—coal, oil, gas. 24 pages—per copy $.75.

4. Report to Executives—This report outlines power services, shows how they serve production, points up profit potentials, gives essentials of sound relation between management and engineers. Use it to help sell your ideas to top management. Price $1.00 per copy.

5. Belts & Chains—20-page report outlines current trends, materials used, and design features of these ever-important power transmission elements. Also covers their selection, application and maintenance. Per copy $.75.

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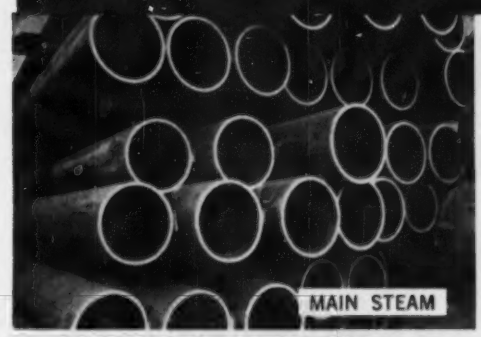
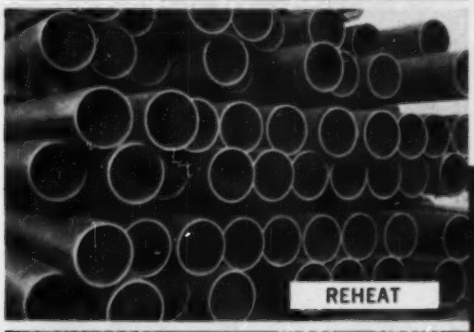
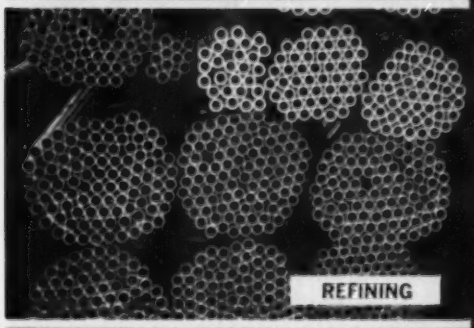
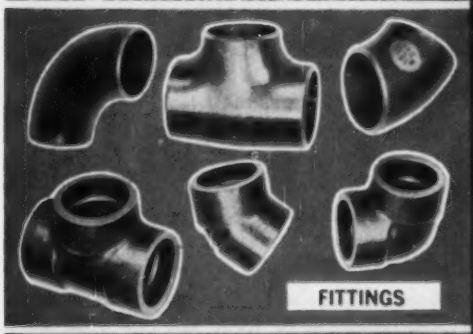
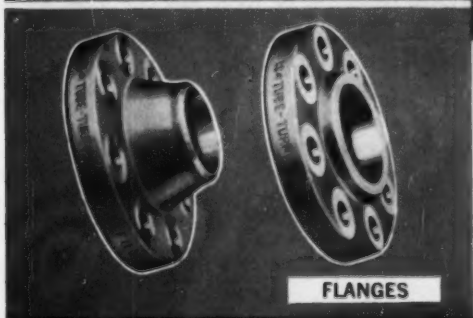










CAPITOL PIPE
WORLD-WIDE

CHROME MOLY
...from Capitol

Shown at left are some of the many special Alloy products carried in inventory.

MAIN STEAM: 8⅝" O.D. through 14" O.D. heavy wall in 1¼% and 2¼% chrome. Also the complete range of Schedule 160 and Double Extra Heavy Walls ½" ips to 8" ips.

REHEAT: 10¾" O.D. through 20" O.D. in all schedule numbers Seamless 1¼% chrome . . . plus Standard and Extra Heavy Walls in all sizes.

REFINING: ¼" ips through 14" O.D. Seamless 4/6% chrome. Special tube sizes, large O.D. and higher chrome analysis also stocked.

FITTINGS AND FLANGES: Seamless Alloy Welding Fittings are carried in inventory to match Standard and Extra Heavy sizes shown above. Forged fittings and flanges are available for quick delivery.

Capitol

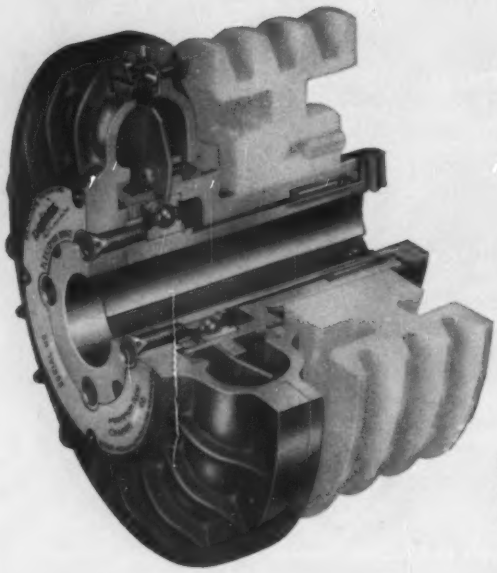
PIPE & STEEL PRODUCTS, INC.

1275 SUBURBAN STATION BUILDING • 1617 PENNSYLVANIA BLVD.
LO. 3-5817 • PHILADELPHIA 3, PENNSYLVANIA

For more facts circle 280 on Reader Service card, p 101

WHAT'S YOUR PROBLEM?...

- ☑ Overheated motors?
- ☑ Excessive belt maintenance?
- ☑ Breakage of materials being processed —like thread, wire, paper?
- ☑ Expense of oversize or high torque motors?
- ☑ High demand rate?
- ☑ Expense of reduced voltage starters?
- ☑ Clutch trouble?
- ☑ Breakage of transmission parts due to instantaneous shock loads?
- ☑ Damage and recurring down-time from overloads?



FLEXIDYNE

THE DRY FLUID DRIVE

It is no longer necessary to accept the destructiveness—the costliness—of conventional starting in the mechanical transmission of power. Flexidyne changes that!

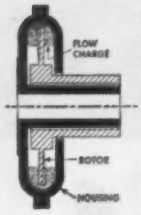
Flexidyne is the new way to start loads *smoothly*—to protect against shock and overload—to save power—all *without any sacrifice of efficiency at full load!*

This revolutionary development is ushering in "the day of the soft start"—which can mean thousands of dollars to you in equipment savings and in better, more economical operation.

Flexidyne is available, off the shelf, in Drives and Couplings. Capacities range from fractional to 1,000 hp. Ask your local Dodge Distributor or write us for technical bulletin.

DODGE MANUFACTURING CORPORATION, 3200 Union St., Mishawaka, Ind.

HOW FLEXIDYNE WORKS



The "dry fluid" in Flexidyne is tiny heat-treated steel shot. A measured amount, called the "flow charge," is contained in the housing, which is keyed to the motor shaft. Inside the housing is a rotor, free to revolve relative to the housing, but connected to the load.

When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, packing it between the housing and the rotor, which transmits power to the load. Initial slippage is momentary. Housing and rotor become locked together and achieve full load speed without slip and at 100% efficiency.

CALL THE TRANSMISSIONEER — your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

DODGE

of Mishawaka, Ind.

Check these improved 1960 insulations

B E H
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you'll want them in your new specifications

Take a Fresh Look at SUPER POWERHOUSE

Insulating—Finishing Cement

You readily see there is an improved whiteness—Super Powerhouse dries *super* white. It withstands rain, sleet and snow after initial set—no redoing jobs because the weatherman erred. It has outstanding coverage, insulates and finishes in one coat yet performs better than many insulating cements.

New advantages such as these make it imperative to check your insulation specifications before rewriting them for a new project. Baldwin-Ehret-Hill offers you the complete line—a selection of over thirty different specialized insulation products for service from sub-zero to 1900 F. Each is designed to give you greater efficiency, easier application and lower installed cost. To bring your specifications up to date, write for our new 1960 catalog or see it in your Sweet's file.

NOW IS THE TIME TO UPDATE YOUR SPECIFICATIONS WITH . . .

BALDWIN-EHRET-HILL

101 Breunig Ave., Trenton 2, N. J. Incorporated • 1897

THE COMPLETE LINE OF INSULATIONS for use SUB-ZERO TO 1900 F.

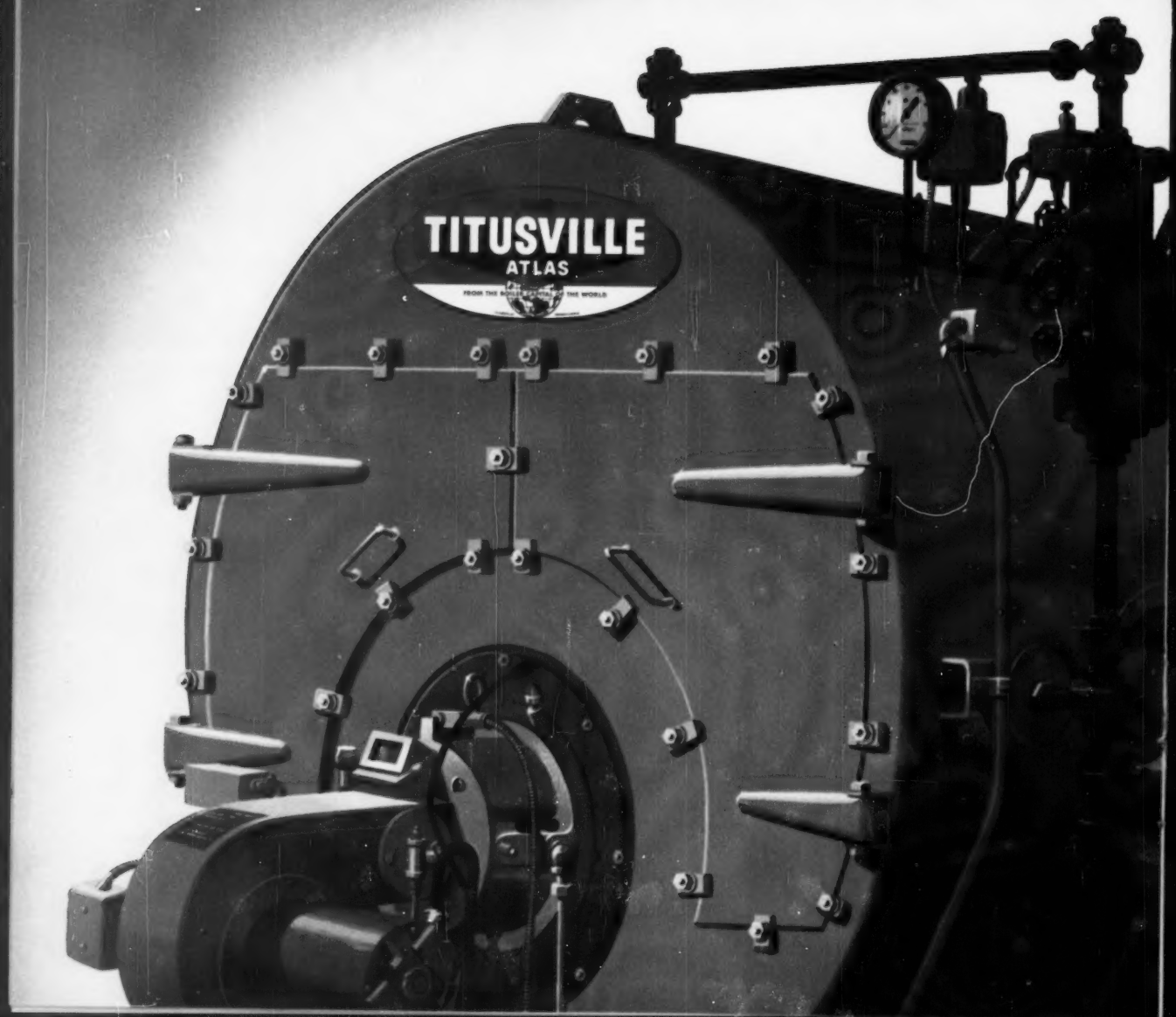
CONTRACT APPLICATION SERVICE FROM COAST TO COAST

circle 282 on Reader Service card, p 101

circle 283 on Reader Service card, p 101 ➤

BONUS

from the Boiler



POWER

Capital of the World . . .

THE TITUSVILLE-ATLAS

BONUS POWER means maintained high efficiency . . . longer life . . . less maintenance . . . more horsepower per total energy input. That's what you get when you install a complete TITUSVILLE-ATLAS unit, the only boiler with a patented wet back.

Wet-back design gives you maintained efficiency by eliminating back end refractories. *Result:* no down time for replacement.

Larger furnace area permits reduced fan requirements. *Result:* lower operating costs. Get BONUS POWER. Specify TITUSVILLE-ATLAS.

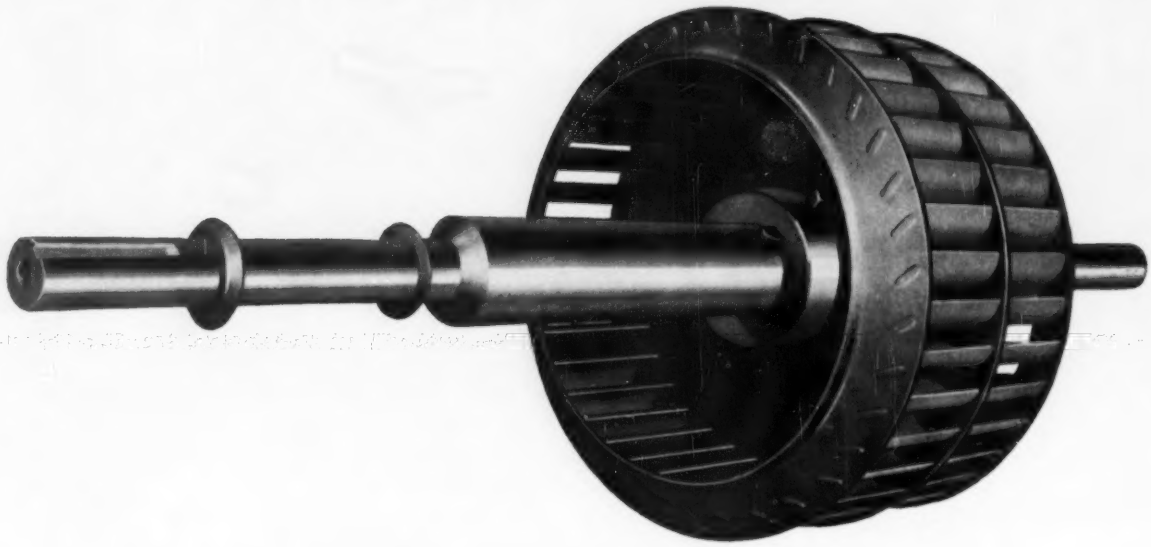
THE TITUSVILLE IRON WORKS COMPANY

TITUSVILLE, PENNSYLVANIA

Division of Struthers Wells Corporation

VMA-6959

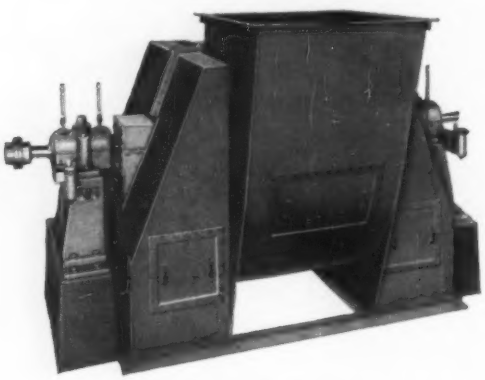
CLARAGE



Takes rough-tough jobs in stride... ADVANCED DESIGN DYNACURVE FAN

In the Clarage tradition of heavy-duty construction, here is induced draft equipment offering numerous advantages:

36 radially deep, aerodynamically curved blades impart dynamic energy to the gas stream which is effectively directed to achieve low tip speed operation.



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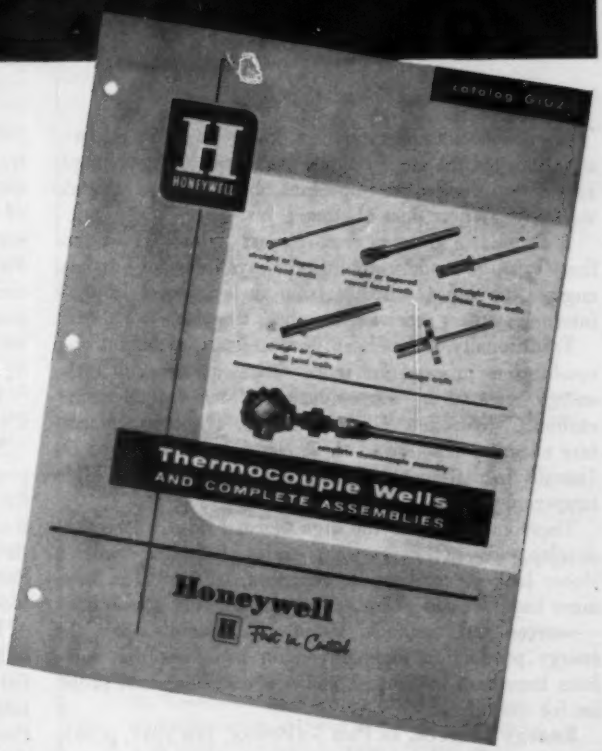

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THERMO REFRESHER NO. 34

By B G A SKROTZKI, Associate Editor

To make our engines and other energy cycles work we have simply assumed that our source energy was ready-made. Now let's get practical and study some of the . . .

Energy sources for power and electricity

To quicken our understanding of engine cycles we have simply called the energy input a quantity Q. This simple assumption dodged an important question—Just how do we get Q? Where does Q come from?

With today's growing research and technology we find that Q can be made a number of ways. Most of our heat engines develop Q directly from fuels injected in their internals; others receive it as a heat transfer.

Traditionally, Q has been produced as the output of a combustion process. In more technical terms it's the energy released by the oxidation of the fuel elements, carbon C, hydrogen H_2 and sulfur S. The high-temperature chemical reaction of these elements with oxygen O_2 (usually from the air) releases energy that produces high-temperature gases.

These gases give us the high thermal head we need to develop efficient energy-work cycles. Before we take a closer look at combustion processes, let's take an even more basic look at overall energy-production possibilities —sources and methods. Table, right, summarizes the energy production and conversion processes that have been important in the past and new ones that hold promise for the future.

Energy sources. In Part 5 (POWER, Jan 1957, p 96), we met the First Law of Thermodynamics and also noted that energy and matter are interchangeable. The First Law as usually stated in thermo says that energy cannot be created or destroyed.

But more accurately, the First Law should say that the sum of energy *and matter* involved in a process cannot be created or destroyed. Our scientists have found that matter and energy are interchangeable; one can be converted to the other. In our sun and the stars these changes go on in either direction. But from a practical-application standpoint on earth, we change matter to energy in significant amounts and only minutely the other way around.

Combustion is a chemical reaction in which a fuel element combines with oxygen and produces a new molecule. The process develops internal energy in the new molecule which shows up as a high temperature of the gas made up of the molecules.

The chemical reaction involves a redistribution of electrons of the oxygen and fuel elements that causes the electrons to lose a small part of their mass. Since one lb of mass equals 11.3-billion kwhr or 38.7-trillion Btu of energy we can see that only a minute part of mass need disappear for the 61,031 Btu produced by the burning of one lb of H_2. The mass decrease is so small that it's impossible to measure in ordinary applications—that's why we didn't know about it until recent years, when scientists developed more refined methods of measurement.

We'll pay detailed attention to combustion later since it's our most important method of making Q.

Nuclear fission also changes mass to energy, but this process involves the nuclei of heavy atoms. By arranging the uranium and plutonium properly we can make neutrons enter the nuclei of these elements. This unbalances the internal forces that hold them together and makes them split into smaller nuclei. The fissioning makes a minute part of nuclei's mass disappear to create energy.

This energy appears as a high velocity of the split parts of the atom. These slam into neighboring atoms giving up part of their kinetic energy and in this way raise the internal energy of the fuel mass. The coolant fluid of the cycle passes over the fuel mass to be heated and carry off the energy to the power cycle. Table lists the nuclear fuel elements we can use.

Nuclear fusion works with light atoms, at the other end of the scale from fission. This process goes on steadily in the stars. Scientists of all nations are busily trying to make the process work on earth. By energizing gaseous molecules to temperatures about 100-million F we get a wild melee of separate nuclei and electrons—no organized atoms—called a plasma.

In contrast to fission, when the nuclei in a plasma can be made to collide and stick together, a minute part of their mass disappears to speed up the fused nucleus and so raise the temperature and internal energy of the plasma. A coolant again would carry off the released energy to a power cycle. This process seems a long way off.

Conversion processes that we use today are largely based on expanding a high-temperature gas or vapor

from a high to a low pressure. Availability of energy depends on the temperature range through which the working fluid can drop.

Most of our engine cycles produce mechanical shaft power to drive a machine or do other duty. Some of the driven machines are electrical generators. These produce an electron flow in a closed circuit that we recognize as an electric current, a form of energy.

The electric form is primarily a convenient way to transmit energy to point of use. There it may be reconverted to mechanical shaft energy, or to internal energy by heating, or to chemical energy or some other form. Most of these are relatively low-temperature processes.

Mechanical energy may in turn be used to produce internal energy, as in a compressed-air system, for transmission to point of use. Some mechanical energy, of course, dissipates by frictional heating.

Electric energy, because of its flexibility, offers many advantages in practical applications. Many efforts are being made to generate electron flows directly from internal energy to avoid processing energy through a relatively complex and bulky engine cycle. This offers important advantages in some energy systems, especially some of those used by the military services.

Thermionic generators receive energy as high-temperature heat at one of a pair of electrodes held in an atmosphere of ionized gas, "boiling out" free electrons that flow through the gas to the nearby "cold" electrode. This creates an electric potential between the electrodes, the hot one being positive and the cold one negative.

Connecting the electrodes through an outside circuit allows an electric current to flow and carry energy. This direct production of electric energy has been done at thermal efficiencies of 8% and more in laboratories. Workers in this field predict thermal efficiencies of 30% with units of 50-mw capacity in the near future.

Thermoelectric generators of modern design use specially compounded semiconductor materials to form two junctions of dissimilar materials. When the like materials are connected electrically in a closed circuit and one junction is heated to a relatively high temperature and the other one cooled, by heat transfer, an electric current flows through the circuit. The energy generated varies with the heat energy transferred to the hot junction and the temperature difference. Thermal efficiencies of 7% have been reported with temperature differentials of about 1000 F.

Workers predict this may soon be as high as 14% when improved materials become available. Arrangement also avoids passing heat through an engine cycle.

This circuit can be used in reverse. When we impress an electric potential across circuit to produce an electric current, one junction heats up and the other cools—so it can be used for refrigerating or heating an object. Present materials produce cooling effects through about a 100-F range. This is expected to be increased to 180 F in the near future. Here we have refrigeration without a reversed engine cycle.

Magnetohydrodynamics, basic field of study of astrophysicists, plays an important part in attempts to develop the thermonuclear fusion process of generating heat energy. Attempts are now being made to apply this knowledge of high-temperature plasmas (ionized gases)

Basic energy production and conversion processes

CHANGING MASS TO HIGH-TEMPERATURE INTERNAL ENERGY

1. Combustion—electron mass changes to internal energy
   - A. Chemical reaction causes oxidation of fuel elements
     - a. Carbon
     - b. Hydrogen
     - c. Sulfur
   - B. Produces high-temperature gases that supply Q to cycle

2. Nuclear fission—nuclei mass of heavy atoms changes to internal energy
   - A. Chain reaction developing neutron projectiles sustains fission process, the physical reaction of fuel elements
     - a. Uranium-233
     - b. Uranium-235
     - c. Uranium-238
     - d. Plutonium-239
   - B. Produces high temperature in fuel metals and highly radioactive fission products that supply Q to cycle

3. Nuclear fusion—nuclei mass of light atoms changes to internal energy
   - A. Confining plasma in limited volume at superhigh temperatures makes nuclei of light atoms collide and fuse
     - a. Hydrogen nuclei (proton)
     - b. Deuterium (proton + neutron)
     - c. Tritium (proton + 2 neutrons)
   - B. Produces superhigh temperatures in plasma and short-lived radiations; may produce electric energy in addition to Q with superhigh thermal head

ENERGY-CONVERSION PROCESSES

1. Primary and secondary processes (high and low temperature)
   - A. Expanding gas and vapor produces mechanical energy
   - B. Mechanical energy to electric energy
     - a. Electric energy to mechanical energy
     - b. Electric energy to heat
     - c. Electric energy to chemical energy
   - C. Mechanical energy to internal energy
   - D. Thermionic—internal energy to electric energy
   - E. Thermoelectric—internal energy to electric energy
     - a. Reversible process to produce thermal change
       - i. Heating
       - ii. Cooling
   - F. Magnetohydrodynamic—internal energy to electric energy

2. Energy conversions at ambient temperatures
   - A. Chemical battery to produce electric energy
     - a. Primary cell
     - b. Secondary cell
   - B. Fuel cell—substitutes low-temperature chemical reactions for combustion to produce electric energy

3. Solar-radiation conversions
   - A. Collection for raising internal energy of matter
   - B. Photovoltaic effect to produce electric energy

to generate electric energy directly from the internal energy of such gases, see POWER, Nov 1959, pp 62-65.

Making h-t ionized gas flow through a strong magnetic field forces free electrons to collect on an electrode. This makes the opposite electrode relatively positive. Connecting electrodes through a closed circuit allows transmission of electric energy originating in internal energy of the hot ionized gas. Proposed cycles anticipate the gas to be still quite hot after leaving the generator. This energy would be the Q to supply a normal engine cycle, a minor fraction of total energy produced by the combination plant.

Chemoelectric production depends on chemical reactions to produce electric energy. Unlike combustion, the reactions take place at room temperature. The ordinary dry cell, technically called a *primary* cell, has been a long-standing method of producing low-voltage dc electric energy.

Another long-standing method has been the storage battery, *secondary* cell; this unit, though, must be charged with electric energy first to cause certain chemical reactions. Then letting the reactions reverse reproduces electric energy; in the strict sense this is not a primary energy source.

Fuel cells using chemical reactions at room temperature are showing promise. By letting fuel elements such as hydrogen or carbon with oxygen diffuse through an electrolyte, electric energy can be produced directly, reducing the fuels to water or CO_2 as in combustion, but at room temperature. Reported efficiences have been as high as 60% which compares with theoretical efficiencies of 80 to 90%.

Solar radiations primarily consisting of heat waves have been an intriguing source of Q for many years. In areas where sunshine predominates most of the year this has limited possibilities. Solar energy has been and is being used to heat water and generate steam. Principal problem is the large area needed to gather big enough amounts of energy to be useful and to develop economical methods of storing the energy for use when the sun doesn't shine.

Photovoltaic cells have proven their feasibility in producing low-voltage dc electric energy directly from solar radiation. The energy can be stored in storage batteries for the hours without sunshine. This method is good for low energy demands, generally not for power.

Combustion. Now let's look at basic details of combustion reactions that release heat in practical energy-work cycles. This involves understanding the chemical reactions used. As a first step let's recall the atomic and molecular weights of the elements and reaction products involved:

Fuel or gas	H_2	C	S	O_2	N_2	CO	CO_2	H_2O
Molecular wt	2	12	32	32	28	28	44	18

The various solid, liquid and gas fuels we use all contain the fuel elements in varying proportion. Each element goes through its own precise reaction with oxygen from the air to release precise amounts of energy per unit mass of fuel element.

In the following sets of reaction equations we give: (1) basic chemical reaction and heat release (2) relative mole volume of elements and reaction product (3) molecular weights of the elements and products (4) relative weights per lb of fuel element:

$C + O_2 = CO_2 + 14{,}096$ Btu per lb C (1)
$1 + 1 \rightarrow 1$ (2)
$12 + 32 = 44$ (3)
$1 + 2.67 = 3.67$ lb per lb C (4)

$2C + O_2 = 2CO + 3960$ Btu per lb C (1)
$2 + 1 \rightarrow 2$ (2)
$24 + 32 = 56$ (3)
$1 + 1.33 = 2.33$ lb per lb C (4)

$2CO + O_2 = 2CO_2 + 4346$ Btu per lb CO (1)
$2 + 1 \rightarrow 2$ (2)
$56 + 32 = 88$ (3)
$1 + 0.571 = 1.571$ lb per lb CO (4)

$2H_2 + O_2 = 2H_2O + 61{,}031$ Btu per lb H_2 (1)
$2 + 1 \rightarrow 2$ (2)
$4 + 32 = 36$ (3)
$1 + 8 = 9$ lb per lb H_2 (4)

$S + O_2 = SO_2 + 3984$ Btu per lb S (1)
$1 + 1 \rightarrow 1$ (2)
$32 + 32 = 64$ (3)
$1 + 1 = 2$ lb per lb of S (4)

Each of the fuel elements releases widely different amounts of energy per pound, H_2 being the highest. Volume of the product of these reactions is one less than volume of elements that went into reaction. This does not hold for all possible combustion reactions, so interpret carefully.

We listed carbon and sulfur as one mole volume each in their respective volume equations. In some combustion calculations this acts as a convenient mathematical fiction (we won't go into this here) but actually they are both solids as we use them. The volume of either, relative to the volume of oxygen used, is so small that it's negligible. So in the physical sense one volume of oxygen entering the reaction results in one volume of combustion product, for these two fuel elements only.

In all the reaction equations for mass (3) the mass of the elements entering the reaction always equals the mass of the combustion product. Again technically the product mass is actually minutely less than the original elements because the disappearing mass converts to the energy released, but the amount is so tiny that we can't measure it and for design purposes we can forget it. So, practically, mass in equals mass out.

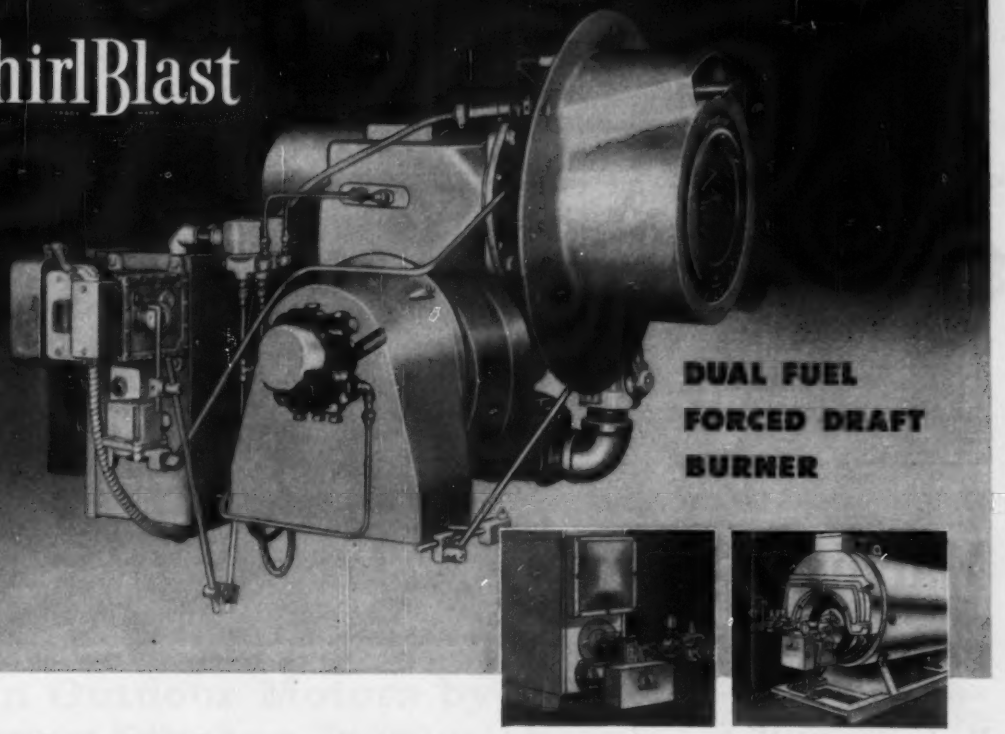
All the equations (4) simply restate the molecular-mass relations in terms of one lb of fuel. For example, one lb of carbon burns with 2.67 lb of oxygen to form 3.67 lb of CO_2 and release 14,096 Btu.

Air supply. Excepting special applications, we get all our oxygen for combustion from atmospheric air. Air is a mechanical mixture of oxygen and nitrogen with small amounts of rarer gas elements. Proportions by weight are 23.1% O_2 and 76.9% N_2 assuming the other elements are negligible. Proportions by volume are 21.0% O_2 and 79.0% N_2. These proportions are accurate enough for most work. This means that by weight we must take in $76.9/23.1 = 3.32$ lb N_2 for every lb of O_2 needed by a combustion reaction.

Next part gives more on combustion calculations.

A new development by Iron Fireman

WhirlBlast



Makes firebox boilers super-efficient

NO SMOKE

Burns clean in less than 10 seconds. The WhirlBlast flame is brilliantly clean almost instantly, and stays clean. Although accepted standards of oil firing allow a 15 minute warm-up period, during which time smoke is tolerated, the Iron Fireman WhirlBlast burner is clean in seconds. Smoke and soot are unburned fuel—completely wasted by smoky starts.

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Low fuel bills; low maintenance. Efficient combustion and low standby loss conserve fuel. Elimination of smoke and soot means no fouled boiler tubes, no carboned nozzles or electrodes; no refractory maintenance expense.

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No special skill to install, adjust, service or operate. The WhirlBlast burner (for gas, oil or dual-fuel combination) comes from the factory fully wired and tested. Bolts to boiler front with firing head through fire door. No special combustion chamber or firing pit needed. Exceptional installation saving.

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"After I showed my guests around the *Sprague*," bellowed Marmy, "we headed uptown to the Duquesne Club for some refreshments."

Marmy's cold headers

My phone rang early Monday morning; there was the feminine voice of Jane Brinkman on the other end.

"Steve," she said pleasantly, "you owe me a martini. I just sold the first set of your *Standard Plant Operator's Questions and Answers* and I had hardly removed them from the package."

Perhaps I should explain that I'm writing this in the fall of '59 and that these books have just come off the press. Jane is manager of our lobby bookstore here in the big green building in New York City.

Visitors from all over the world drop in to see Jane. She makes a business of knowing enough about the books she sells to help her guests, and has tables, just like a library, where people can sit comfortably while appraising each book before purchasing. All in all, spending a few hours browsing around Jane's store is a pleasant experience.

"OK," I said. "I promised you a martini—where will it be?" "Why, at the Bent Propeller Bar, where else?" was her reply.

So at noon we strolled into that hangout for seafaring characters down near the waterfront. After finding a table, I walked over to Marmy at the crowded bar and plunked down the two volumes before him. "These books will help a guy operate everything from cooling towers to nuclear plants," I said to the old consultant, who was contemplating his bottle of Sandpaper Gin.

"BILGEWATER on cooling towers; I'll tell you Btu squeezers how I tamed a flock of cold headers and all I did was let them have their own way," he roared in his foghorn voice.

That did it. The noisy place quieted down as suddenly as if an atom bomb was ticking. Marmy ballasted his deep tanks from the bottle of Sandpaper Gin, then backed up to the bar to face his audience. After giving his grey derby a starboard list, he bellowed away.

"Back in 1941 I was chief engineer of the towboat *Sprague*. She was launched in 1902 and was a paddlewheel job 318-ft long, the biggest towboat ever built. '*Big Mama*' was famous for having pushed a 62-barge coal tow of almost 70,000 tons from Louisville to New Orleans in 1907. That tow covered some seven acres.

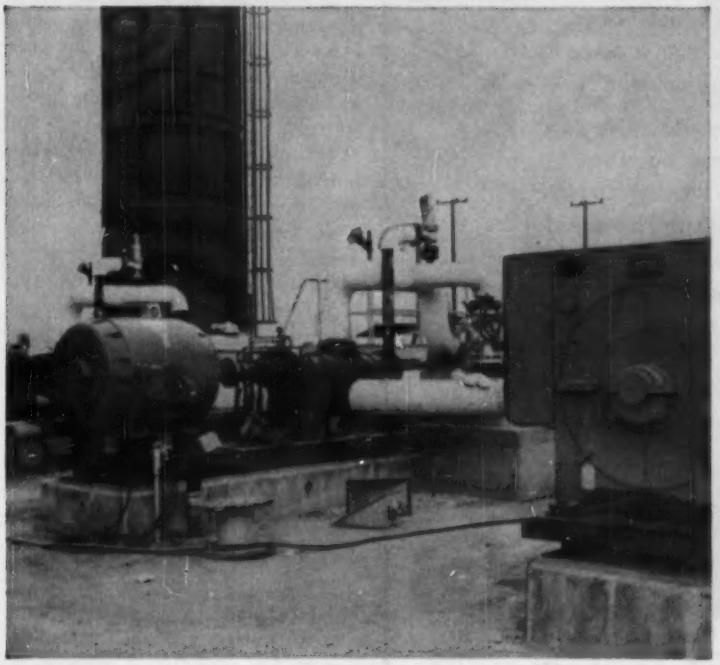
"One noon we tied the *Sprague* up in Pittsburgh after a hard-luck trip from Cincinnati. I was happy to go ashore soon as we secured *Mama's* plant. In those days the Fort Pit Hotel was my hangout.

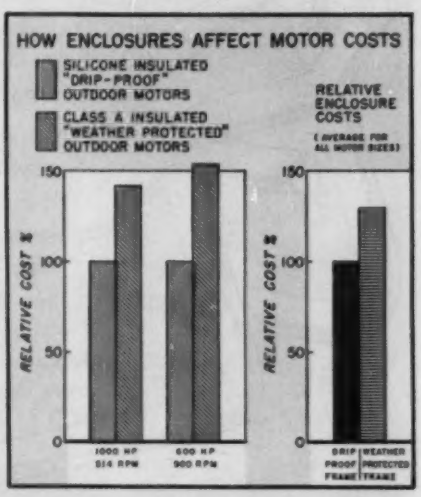
"First person I ran into in the dining room was my old shipmate Duke Sloan. Duke had just taken over as plant engineer of a large industrial firm in Pittsburgh. They made bolts, nuts, wire products and nails. After a few drinks Duke told me that his biggest headache was keeping production machinery from dancing around the floor.

" 'Take our big cold headers,' he griped. 'Those 50 machines reciprocate with such a violent kick while cold-forming the bolt heads that they keep shearing off their own holding-down bolts. Hell, we've tried everything. But the tighter we bolt them down, the quicker they seem to shear off. We've got over 200 machines in all, all dancing,' he continued. 'But those 50 cold headers are the worst. They have to have their anchor bolts

SILICONE NEWS from Dow Corning

Banish Costly Enclosures





Save on Outdoor Motors by Specifying Silicone Insulation

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Both motors have 400-hp ratings. The difference in weight between the two motors is well over 1,000 pounds. Why is one motor so much larger than the other? Because the smaller Allis-Chalmers motor has a self-protected Silco-Flex insulation system incorporating Silastic®, the Dow Corning silicone rubber. The other motor is insulated with conventional materials requiring the protection of a more elaborate enclosure.

Despite its much smaller size, the silicone insulated motor also has a 15% service factor not found in the larger unit. This extra cushion against overloads assures greater reliability and longer life for the smaller unit.

Silicone rubber insulated motors for pump drives, fan drives, or other applications can withstand torrential rains, corrosive fumes, fly ash, dust, salt air, snow, sleet, cold, heat . . . even flooding! That's why it's wise to specify motors with insulation systems made from Dow Corning Silicones for greater reliability and maximum savings.

For more information, write Dept. 6901.

Savings of 30% and better result from specifying motors with insulation systems made from Silastic. Silicone rubber produces a homogeneous, resilient insulation system unaffected by heat, cold, moisture, abrasives, many chemicals and corrosive atmospheres. No need to buy expensive enclosures. Insulation systems made of Silastic are self-protecting, permit open enclosures outdoors where weather-protected frames would otherwise be required. There's no need for a premium priced enclosure to protect the insulation.

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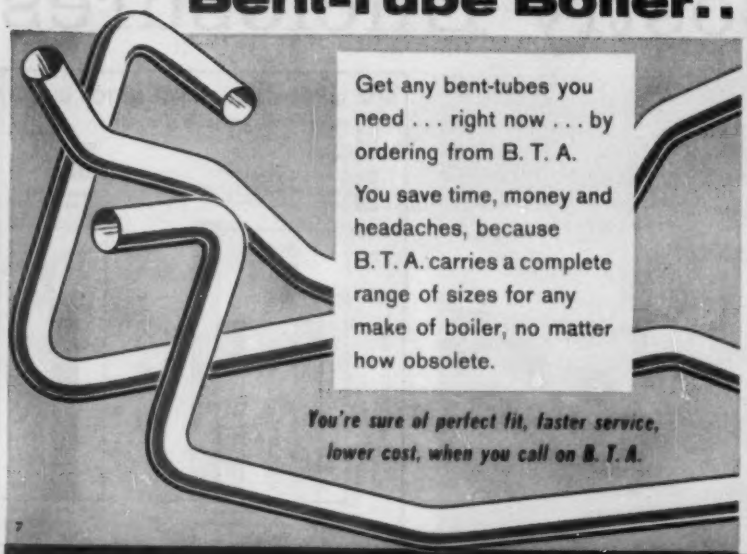

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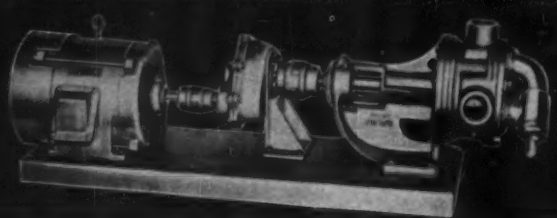

Fig. 288

...do you have such

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See Our Catalog in Sweet's Industrial Construction and Plant Engineer's File

Marmaduke

Begins on page 142

renewed every three to six months.'

"'That's not hard to understand,' I answered. 'With the constant machine-gun action the base becomes a punch press acting at right angles against the bolts.' Then I had a brainstorm.

"'Look here, Duke,' I said, slapping him on the back. 'What's it worth to your firm to have me fasten down the 200 machines so they stay down?'

"Duke looked at me for a full minute. Then he asked, 'Are you kidding, Marmy?'

"'Do I ever?' I shot back.

"'No, I guess you don't, not when you talk machinery,' he admitted. 'But I think you're swimming upstream this time. I say that because the works super has one of those highbrow technical-genius friends of his on the problem. I understand that guy's in the Einstein class when it comes to pure theory. And you know what he recommends?'

"'What?' I asked.

"'He wants us to replace those 1-in. anchor bolts with inch-and-a-half, especially on the 50 cold headers. Hell, that means we gotta slide each machine off its base, remove the old bolts from the concrete foundation, put in new bolts, then lower the machine over them again, level it and bolt it down. That genius is at the plant right now, making further studies on the foundations.'

"'That's OK with me, Duke,' I answered. 'You tell the front office that I can do the job and guarantee those machines won't have to be touched for five years.

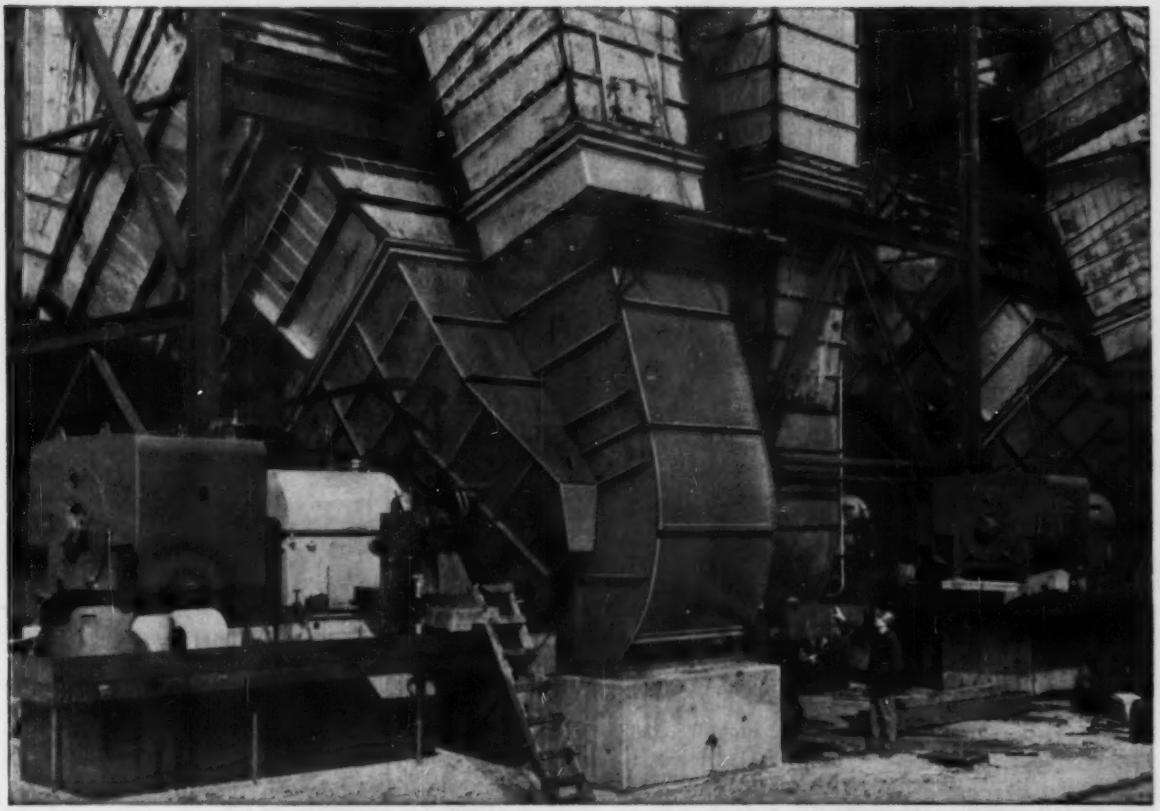
"Five years?' echoed Duke, doing a double-take.

"'That's right,' I said. 'I'll drop into your place tomorrow about ten, if you care to set it up with the top brass.'

"Soon as Duke left I put in a long-distance call to my good friend Parker Wheeler in New York City. Parker made his living by trouble-shooting vibration problems all over the country. I just wanted to double check before locking horns with Duke's expert.

"'Hell, no,' barked Parker into the phone. 'Tell 'em those machines won't have to be touched for ten

For more facts circle 289 on Reader Service card, p 101



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The "Buffalo" Family of "BLH" Fans is designed for highest mechanical efficiency over an extremely broad operating range. Peak efficiencies are up to 86%. Rugged "Buffalo" construction insures economical, dependable operation throughout a long, trouble-free life.

"Buffalo" Type "BLH" features include: streamlined housing designed to deliver ultra-smooth air flow, peak static conversion and pressure distribution at outlet — turbulence minimized by smooth inlet bell, directional inlet vanes, backward-curved blades, matching rotor flange and inlet bell and gradually divergent outlet. These features all add up to the quiet, powerful, smooth performance characteristic of the "BLH".

Reliable, maintenance-free operation is the result of extra-heavy construction throughout. This includes sturdy steel plate construction ruggedly welded for extra strength — oversized shafts and bearings. Rotors are statically and dynamically machine balanced at factory.

If your mechanical draft conditions require a dependable fan that provides high efficiency over a broad operating range, ask your "Buffalo" engineering representative for complete facts about the "Buffalo" family of mechanical draft fans. Or you can write us direct for Bulletin FD-905.

"Buffalo"

BUFFALO FORGE COMPANY
Buffalo, N. Y.
Buffalo Pumps Division • Buffalo, New York
Canadian Blower & Forge Co., Ltd., Kitchener, Ontario

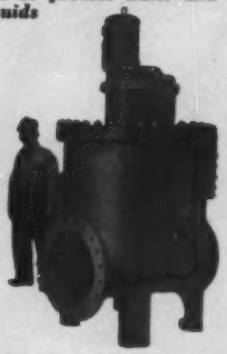
VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

More clean water at a lower cost with

S.P. KINNEY AUTOMATIC SELF-CLEANING

STRAINERS

. . . for efficient removal and disposal of suspended particles from raw or process water and other liquids



- Over 1000 installations
- 2" to 48" pipeline sizes
- Installation on pressure or suction side of pump

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S. P. KINNEY ENGINEERS, Inc.
CARNEGIE PENNSYLVANIA

circle 291 on Reader Service card, p 101

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USE THE FREE ORDER CARD IN THIS ISSUE

Marmaduke

Begins on page 142

years after you do the job. But it's still good business to renew the mountings every five years.' That's all I wanted to hear.

"When I showed up at the plant next day, it looked like Duke had everyone there but Sitting Bull. There must have been a dozen big shots waiting to give me the third degree, including the technical brain.

" 'So you're the genius who's gonna anchor the cold headers so they stay down for five years,' said Franklin Davis, the president. 'And to think we've had to renew their bolts every few months.' The boys laughed good-naturedly.

"Before I could answer, he continued, 'Dr Rajeshwar here has been making highly technical studies of our vibration problems. He's even taken ground borings under the foundations. Then he analyzed the concrete for compression and tension characteristics. He's had our laboratory analyze the steel in the holding-down bolts for point of crystallization and for horizontal impact thrust. Result is these graphs and calculations,' he added, pointing to a bale of papers on his desk. 'And right now he's working on the theory of steady-state response of lumped parameter systems.'

" 'Mr Davis,' I shot back, when I finally had a chance to stick in my oar, 'I don't know a damn thing about lumped parameters and points of crystallization, and I care less. But I'll not only guarantee that by my method those machines'll stay anchored for five years—I won't even use bolts.'

"For a few seconds the quietness was so loud you couldn't hear yourself think. Then everyone eyed Dr Rajeshwar, who was looking right through me as if trying to read my mind.

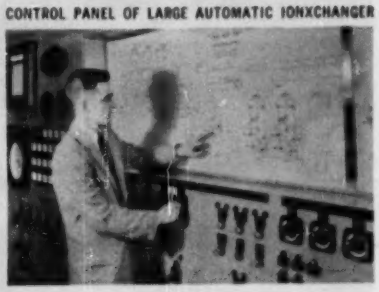
" 'You won't bolt them down?' he finally echoed, almost in a whisper.

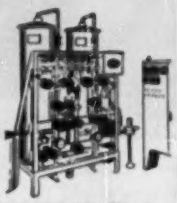
" 'That's right,' I shot back. "I'll cement ½-in.-thick flexible felt mounts under them. And before any of you boys think I've stripped my gears, I'll tell you why. The tighter you try to fasten down those reciprocating cold headers, the quicker they're going to work-harden their holding-down bolts. And once the bolts are

MORE "ON ORDER"

ILLCO-WAY ionXchange EQUIPMENT

CONTROL PANEL OF LARGE AUTOMATIC IONXCHANGER





Automatic IonXchanger shipped fully assembled, ready for hook-up.

We have been designing and building Automatic IonXchangers since 1943. Some of the earliest units are *still in successful operation*. The current projects listed below range from small equipment for process applications, selling for under $10,000, to large and elaborate installations priced in the hundreds of thousands.

AUTOMATIC IONXCHANGERS ARE NOW IN PROCESS FOR THESE BUYERS

- ★ MUNICIPAL POWER PLANT IN TEXAS
- ★ CHEMICAL PLANT, UPSTATE NEW YORK
- ★ MIDWESTERN POWER COMPANY
- ★ NUCLEAR POWER PLANT IN EAST
- ★ ANOTHER TEXAS MUNICIPAL POWER PLANT
- ★ NUCLEAR POWER PLANT IN MIDWEST
- ★ EASTERN POWER COMPANY
- ★ MUNICIPAL POWER PLANT, OHIO
- ★ CANADIAN NUCLEAR POWER REACTOR
- ★ CHEMICAL PLANT IN CALIFORNIA
- ★ TWO MORE MIDWEST POWER PLANTS
- ★ SOUTHWESTERN POWER COMPANY
- ★ EASTERN ELECTRONICS PLANT
- ★ METAL PROCESSING PLANT, CALIFORNIA
- ★ ONE MORE TEXAS POWER COMPANY
- ★ EASTERN RUBBER PROCESSOR

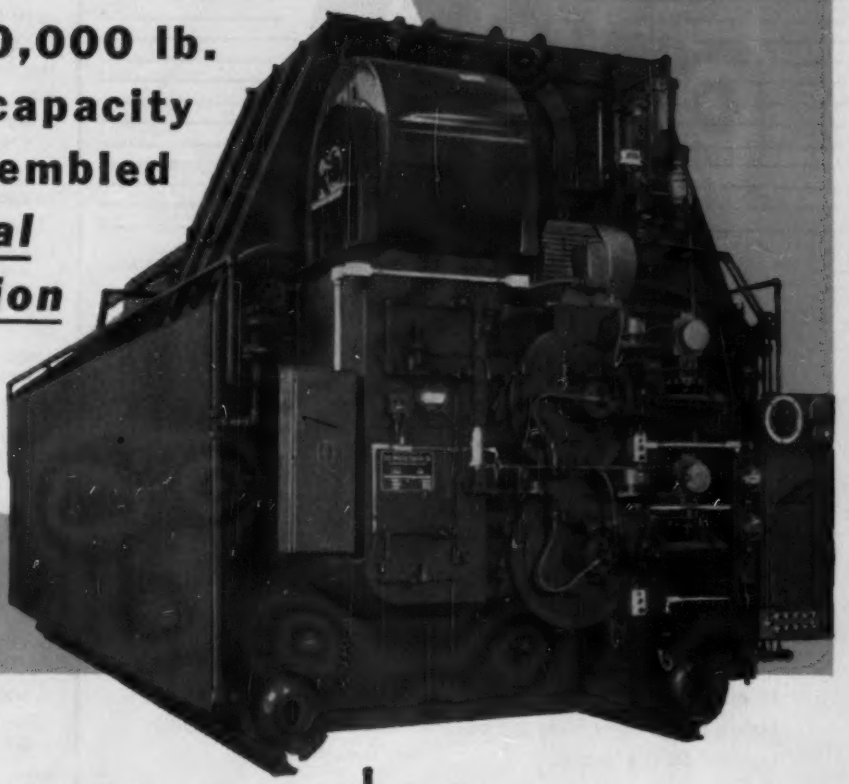
In addition to these water treatment installations, orders now in process include large Automatic IonXchangers for special chemical processing applications.

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

circle 293 on Reader Service card, p 101

...now from WICKES

a new 100,000 lb. per hour capacity shop-assembled *natural circulation* boiler



Wickes Type A units are of simple design, ruggedly constructed and adaptable to a variety of operating conditions and may be fired with oil, gas or combination of both.

All units are shipped completely shop-assembled including superheater, fuel burning equipment, safety and combustion controls, forced draft fan and drive, soot blowers and feedwater regulator.

Save on

- First Cost
- Operating Expense
- Space
- Delivery Time
- Installation Time

For more detailed information on Wickes Type-A steam boilers, write for our catalog 56-1. Bulletin 55-1 covers the complete line of Wickes Products and Facilities.

WICKES type A

WICKES

WICKES BOILER CO., SAGINAW 10, MICHIGAN

DIVISION OF THE WICKES CORPORATION

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* Boston • Chicago • Cleveland • Dallas • Denver • Detroit • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • New Orleans • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tulsa.

For more facts circle 294 on Reader Service card, p 101

NEW! Monoflange valve is guaranteed drop-tight at 150#

The Henry Pratt Monoflange MK II is a top quality butterfly valve that fits between the pipe flanges of a fluid or gas line. **It saves weight, space and labor** because it eliminates a pair of flanges and requires only one bolting operation. **It eliminates gaskets** because the faces as well as the inside of the valve body are covered with rubber permanently bonded to the metal.

Low torque makes the Monoflange easy to operate, especially with Henry Pratt's **new SIDEWINDER manual operator.** Any type of power operator can be used if desired. Structural features include streamlined disc, one piece shaft, chevron packing and Nylon bearings. Various materials available for corrosive liquids.

Standardized and mass produced, this new valve offers famous Henry Pratt quality at a new low price . . . you can't find a similar valve that offers so much in quality or performance.

Complete information available. Water and gas flow data, valve sizing, operator selection in 26 page brochure. An ideal tool for the engineer working with and specifying valves. Write for Bulletin 10K.

Creative Engineering for Fluid Systems

HENRY PRATT®

Monoflange MK-II
RUBBER SEAT BUTTERFLY VALVE

Henry Pratt Company, 319 W. Van Buren St., Chicago 7, Ill. • Representatives in principal cities

Marmaduke

Begins on page 142

crystallized they snap like glass. It's just common sense. So your solution is to let them have enough freedom to roll with the punch—let them float on felt mounts. Of course the mounts have to be made to the right density for these machines. Then just cement the mounts to the floor and you'll have enough motion to absorb the vibration.'

"'But according to my calculations,' commented the good doctor, cautiously, 'those machines will go right through the wall if your cement lets go.'

"'I saw a test a few years ago,' I answered, 'where the concrete came up with the felt when they tried to remove it without the proper solvent.'

"Then everyone came to life, shooting dozens of questions at me. But they were finally satisfied. Davis said he'd give me $500 if my felt-mount idea worked as I thought it would.

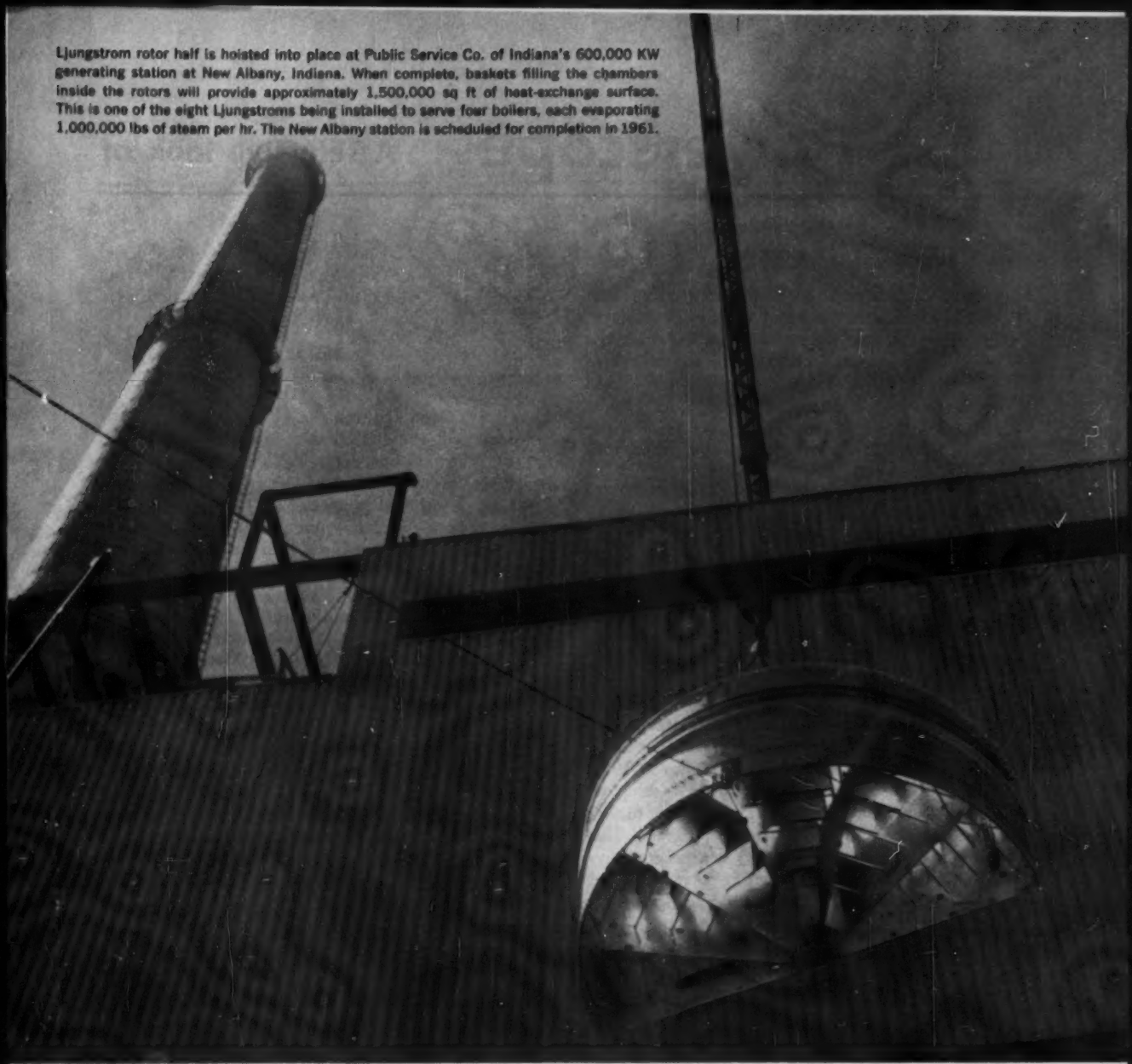
"When the *Sprague* tied up in Pittsburgh from Memphis a few months later, I called Duke. He told me the machine they anchored with cemented felt mounts was doing so well they were planning doing all 200 of them.

"My next trip to the steel city was a week before Christmas. Evidently Duke had read about our arriving in town in the local papers. He and some top brass from his firm were on hand when we tied up. After I showed them around the *Sprague*, they asked me to have lunch with them at the exclusive Duquesne Club uptown.

"Soon as the cocktails arrived, Davis offered a toast. 'Here's to Mr Surfaceblow and his little felt mounts,' he said, lifting up his glass. 'And here's something to make your Christmas a real merry one,' he continued, handing me an envelope. Tearing the envelope open, I pulled out a check for $1000.

"'Those machines are working so well now that we feel they'll save us thousands of dollars in routine maintenance, not to mention the anchor-bolt headaches,' explained Davis. 'And you earned every last cent of that check. As you promised, the solution was simple as letting the machines roll with each punch.'"

—STEVE ELONKA



Ljungstrom rotor half is hoisted into place at Public Service Co. of Indiana's 600,000 KW generating station at New Albany, Indiana. When complete, baskets filling the chambers inside the rotors will provide approximately 1,500,000 sq ft of heat-exchange surface. This is one of the eight Ljungstroms being installed to serve four boilers, each evaporating 1,000,000 lbs of steam per hr. The New Albany station is scheduled for completion in 1961.

BEHIND NEW ALBANY'S **LJUNGSTROMS®** —**LIFETIME AIR PREHEATER SERVICE**

One of the major reasons why Public Service Co. of Indiana, Inc., chose Ljungstrom for its new generating station at New Albany is Lifetime Air Preheater Service.

Lifetime Air Preheater Service means that Ljungstrom engineers make regular calls *throughout the life of each unit.* They check to make sure your Ljungstroms are working at top efficiency, and that they'll continue to work that way. This service policy covers all Ljungstroms—right from the very first installation made in 1923.

But that's not all. Air Preheater provides first-rate *emergency* service, too. For instance, a Ljungstrom customer in the southwestern U.S. recently called on a Wednesday night for replacement parts. Air Transport looked like the fastest way, but schedules indicated a minimum three-day delivery time. So Air Preheater loaded the parts on a pickup truck, and their men drove them more than 1,000 miles to their destination...34 hours straight driving. The parts were installed and in service by Friday morning.

Fast response to emergencies and regular inspection of Ljungstrom installations are two of the many advantages Air Preheater provides. Another is expert knowledge of boiler and preheater problems gained from over 35 years' experience. Perhaps these reasons explain why 9 out of 10 preheaters sold today are Ljungstroms.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more facts circle 296 on Reader Service card, p 101

Powerscope . . . A selective look at

Another largest

Largest single-shaft steam turbines are being built by English Electric Company for the Drakelow C Power Station near Burton-on-Trent, England. The two 350-mw units turn at 3000 rpm and have three cylinders driving a direct-cooled alternator. Steam conditions are 2400 psig, 1050/1050 F; turbine exhausts at 1.3-in.-Hg abs. Generator has a water-cooled stator winding and cools the rotor with 45-psig hydrogen.

Latest claim from U.S.S.R. states that Ogra thermonuclear installation has achieved new high in temperature of a plasma in a 20-meter main duct. They report 6 million C (10.8-million F); believe they are just one step from controlled nuclear fusion.

Updating teachers

About 18,000 high-school and college teachers in science, mathematics and engineering will get financial aid to attend 379 Summer Institutes in 1960. The National Science Foundation, Washington, D.C., will make over $21 million available to 265 educational institutions to carry on program. This fund pays tuition and fees for the teachers, pays stipends up to $75 weekly during attendance and gives allowances for travel and dependents. Institutes vary from 4 to 12 weeks.

New tidal-power scheme

First tidal-power system of the U.S.S.R. will be built on Mesen Bay of the White Sea. Plan includes a dam 62 miles long made from precast concrete sections 3.8-in. thick. Dam will hold 2000 submerged turbine-generators that can run in either direction as tide flow changes twice daily.

At the ASME Annual Meeting in Atlantic City, A R Matthews, President of Consolidation Coal Co, reported that U.S. electric utilities are expected to burn 400- to 475-million tons of coal annually in 1975 (this compares to about 170-million tons for 1959). Total coal market for all uses today is some 400 million tons while the producing capacity is about 500 million tons. In 1948, prior to dieselization of U.S. railroads, the capacity was about 650 million tons. Unit output of the mines, about 12 tons per man day, is 90% more than ten years ago. This helps to offset the miners' basic wage rate which has risen from $13.05 to $24.25 since 1948, and welfare-fund payments which rose from 10c to 40c per ton. In 1948 average mine price was $4.99 per ton, in 1958 this dropped to $4.86 per ton and is less today. Coal transportation costs may fall somewhat and then will probably remain steady for many years into the future.

New major hydro plant

Glen Canyon Dam on the Colorado River in Arizona will stand 13 miles downstream from the Utah-Arizona line. This key unit of the Colorado River Storage Project will rise 700 ft above bedrock. Eight steel penstocks, 15-ft dia, will lead the water to as many 150-rpm 155,500-hp Francis turbines. The 900-mw plant will rank third among the Bureau of Reclamation plants, behind Grand Coulee's 1974 mw and Hoover's 1354 mw. Of seven bids received for building the eight turbines, the four low bidders were: English Electric Export and Trading Co, Ltd, $6,214,000; Baldwin-Lima-Hamilton Corp, $6,392,000; the Nichimen Company, $6,585,000; Allis-Chalmers Mfg Co, $6,795,000.

Curtiss-Wright Corp claims to have developed a radically new internal-combustion engine jointly with NSU Werke of West Germany. No details have been released that give any clear idea of its mode of operation. Working on a "trochoid" principle, it has only two moving parts: a rotor and a crankshaft. Gasoline-air mixture enters the engine through a wall port. The turning rotor compresses mixture and fires it with a single spark plug. Engine runs at a fuel consumption of 0.45 lb per hphr and lower, has low noise level.

Ten power companies have joined Avco Corporation in a research project to explore the possibility of using the magnetohydrodynamic cycle for power generation, see POWER, November 1959, pp 62-65. The utilities include: Appalachian Power Co, Central Illinois Light Co, The Dayton Power and Light Co, Illinois Power Co, Indiana & Michigan Electric Co, Indianapolis Power and Light Co, Kansas City Power & Light Co, Louisville Gas and Electric Co, Ohio Power Co and Union Electric Co. American Electric Power Service Corporation will act as agent for the ten utilities in carrying out the joint research project with Avco-Everett Research Laboratory in Everett, Mass.

Preparing for nuclear war

Experimental site for the first ultramodern underground nuclear-bombproof city in the U.S. will be 35 miles from Albany, N. Y. Prof F W Edmondson of Cornell University assisted by a group of 25 chose communities

of Middleburg, Schoharie and Cobleskill because limestone formation there will make excavation easy. Tentative plans include a manufacturing plant with 1500 workers. A nuclear reactor will supply power for the underground chambers to house population of the area, machinery, food and supplies.

U.S.A leads U.S.S.R.

In a report by E Vennard, Vice President and Managing Director of Edison Electric Institute, the 1958 capacity of U.S.S.R. was set at 53.1-million kw compared to 160.2 million for the U.S.A. Russian goal for 1965 is 108-million kw and the U.S.A. goal for the same year is 245-million kw. Russia does not plan any large-scale development of atomic plants until they compete economically with fossil-fuel-fired plants. About 80% of total kwhr is consumed industrially compared with about 50% in the U.S.A. Our homes use an average of over 3400 kwhr yearly while the average Russian home uses only 400 kwhr. U.S.S.R. now produces over 1000 kwhr per capita compared to over 4200 kwhr per capita for U.S.A. These are valid indexes of how the two countries compare economically.

In a talk before the American Society of Civil Engineers, G T Ingalls of Ebasco International Corp cited problems an engineer meets in designing and building plants for Latin American countries—these are not necessarily true of all countries: (1) long delays in getting import permits (2) delays in shipping because suppliers are not ready to handle export material (3) lack of skilled labor (4) language barriers with labor (5) getting spare parts to maintain construction equipment (6) limited use of local materials (7) inability to obtain complete weather data.

Bargain-basement sheepskins

Engineering and Scientific Newsletter No. 122 carries this item: "Report from the American Council on Education—American Degree Mills—concerns the operation and means of controlling institutions selling diplomas without academic requirements. The Council states that the diploma mills, as many as 200 in 37 states, calling themselves 'colleges or universities' and offering 'quick-way' degrees, usually mail-order, are taking about $75 million annually and heavily damaging U.S. prestige abroad. Although many national professional organizations were interested in this problem, the Council found limited knowledge and actual misinformation among the 21 organizations canvassed."

Spain has joined the network that exchanges electric energy between Austria, Belgium, France, Germany, Italy, Luxembourg, Netherlands and Switzerland. Spain will get power from Portugal and France in plant-breakdown emergencies. It can also contract for seasonal supplies lasting up to six months during bad hydro years. Distant countries such as Belgium and Germany can supply Spain by compensating France for power fed to the Spanish network. During good hydro years Spain can export surplus power—over two-thirds of Spanish generating capacity is hydro. The 1958 network consumption was 260,000 mwhr of which about 7500 mwhr was interchanged between countries. Austria is the only long-run net exporter among the countries. It exports an average of 12% of its total production, mostly to Germany.

Hyperjet passes tests

The Marquardt Corporation completed a series of tests on its hyperjet engine at simulated speeds and altitudes higher than ever before achieved with an air-breathing power plant. The engine integrates best features of the ramjet and rocket systems in a single propulsion unit. Engine ran at flight speeds over five times sonic speed at simulated altitudes above 100,000 ft. Engine runs as a rocket during launching, low-speed boosting, space flying and re-entry phases, using a stored oxidizer for combustion. It runs as a ramjet during high-speed boosting and hypersonic cruising phases, taking air from the atmosphere.

The Tacoma Public Utility Board decided to exclude foreign manufacturers from bidding on generators, transformers, switchgear and other heavy equipment needed for the Mayfield Dam powerhouse. The Board accepted the recommendation of Tacoma City Light by a margin of only three to two; two commissioners asserting that foreign equipment could save as much as $5 million. Allis-Chalmers already has the contract to supply turbines for the 160-mw project. Decision to limit bidding to U.S. and Canadian firms was that only they had adequate repair facilities.

Hams Hall Power Station in Birmingham, England claims a world record for overhauling a 60-mw boiler-turbine unit by doing it in five days—nine days better than previous record. Advance schedule eliminated stoppages and waiting time. Unlimited labor was available and work continued day and night in 12-hr shifts. Despite heavy labor costs, estimates show a saving of about $28,000, mostly from avoiding old standby-capacity operation.

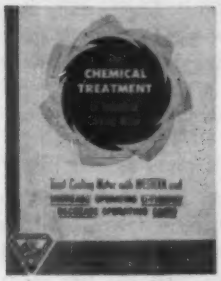
Write Western Today!

For these technical bulletins on

Water, Steam & Fuel Treatment

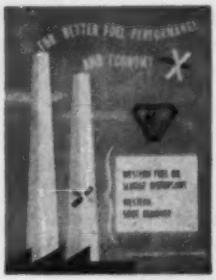
The Chemical Treatment of Boiler Feed Water. This technical bulletin contains a clear explanation of the causes of boiler water problems and Western's methods of solving them. Special emphasis on scale prevention, corrosion control, sludge dispersion, and suppression of foaming and carry-over.

Steam Plus CORAVOL Equals Protection From Corrosion. This technical bulletin tells how CORAVOL, the original amine process, gives complete protection from corrosion to your entire steam-condensate circuit. Clearly explains the theory of corrosion and the application of volatile amines to steam systems. Cites typical case histories of the use of CORAVOL in various plants and industries.



The Chemical Treatment of Industrial Cooling Water discusses common cooling water problems—scale, corrosion, algae, slime. Also presents Western's proven methods for controlling and preventing these conditions in cooling towers, evaporative condensers, process heat exchangers, engine and compressor jackets, chilled water systems, etc.

Better Fuel Performance and Economy discusses the causes and effects of sludge in fuel oil supplies and soot deposits in combustion areas. Shows how these troubles can be eliminated economically, dependably, and permanently with time-tested special Western formulas.



Also, Technical Bulletins on the chemical treatment of potable and plant water supply—refrigerating brine—sweet water systems. Also, the use of Dry Acid Scale Removers.

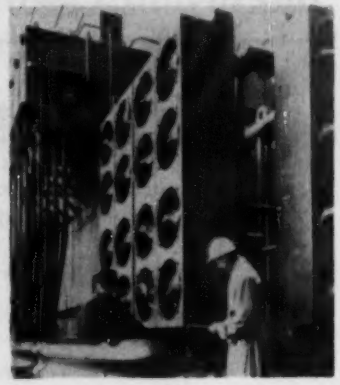
WESTERN CHEMICAL COMPANY

Whatever your water, steam or fuel treatment problem may be, you can rely on special Western formulas and individual technical service to solve it dependably and economically.

WESTERN CHEMICAL COMPANY

713 Washington Street, Kansas City 5, Mo.

Reports from the field



380-mva generator transformer installed

Fisk Station of the Commonwealth Edison Company near Chicago, Ill. received a 380-mva generator transformer to step up generator voltage from 18 to 69 kv. Cooled with forced oil-to-air heat exchangers, the unit has an installed weight of 554,000 lb. It was shipped upright in one piece minus bushings, coolers and oil by Westinghouse Electric Corporation.

The generator transformer is actually larger than its nominal rating of 380 mva. It has two separate high-voltage windings each rated at 210 mva giving it an equivalent capacity of 400 mva.

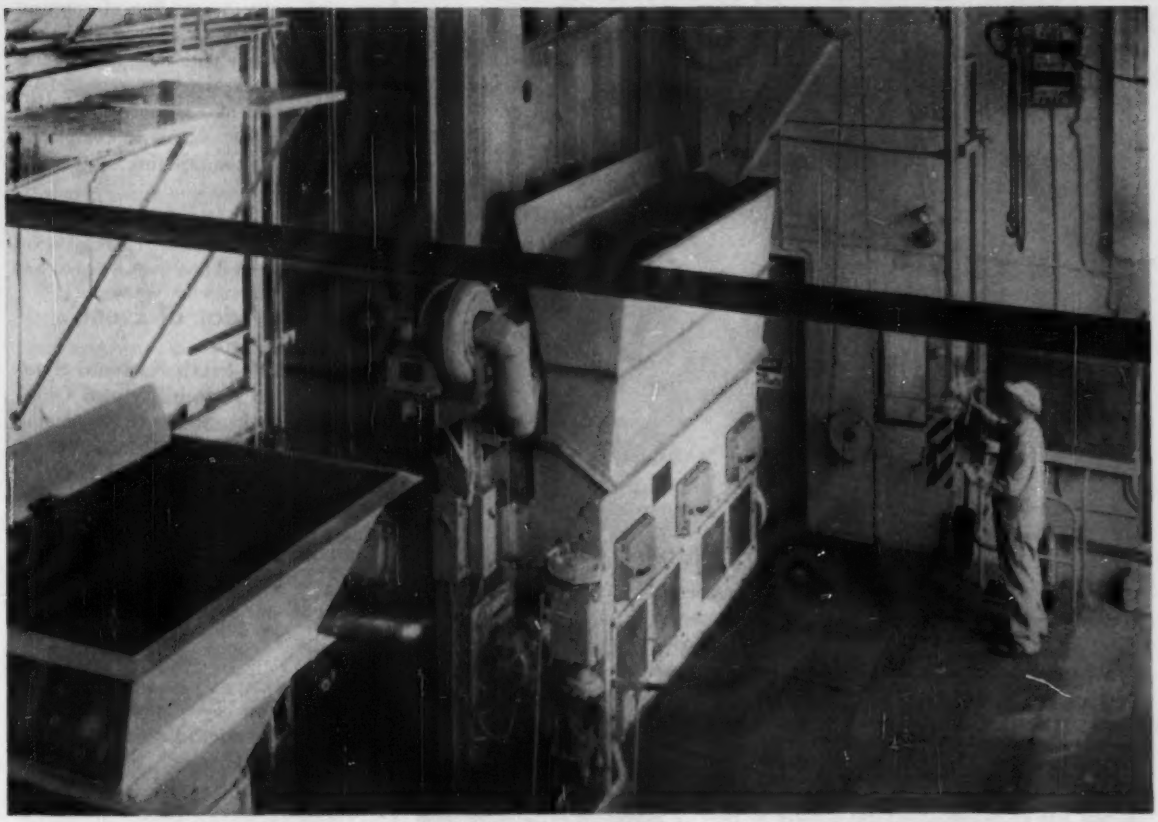
Dallas exposition scheduled for February

The 2nd Southwest Heating & Air Conditioning Exposition, to be held in Dallas Memorial Auditorium on February 1 to 4, will feature equipment with the ability to balance out effects of unpleasant weather in any climate by simple adaptations of basic design. New adaptations of evaporative cooling, heat pump and many supplementary heating units will be significant features.

The Exposition, under the auspices of the American Society of Heating, Refrigerating and Air Conditioning Engineers and in conjunction with their meeting, has drawn exhibitors representing the full scope of the heating and air-conditioning industry. Attending will be visitors from the 50 states and foreign countries.

Equipment to be exhibited includes

at S. C. Johnson & Son, Inc.



On the line in October 1954, this 40,000-lb B&W boiler, fired by AE Vibra-Grate Stoker, has never had an unscheduled shutdown. Cost of repairs to previous stokers ran close to $1000 per year.

Five-year repair bill for Vibra-Grate Stoker... only $188!

(vs previous stoker costs of $1000 a year)

The AE Vibra-Grate Stoker installed at S. C. Johnson & Son, Inc. (makers of Johnson's Wax Products), Racine, Wisconsin, continues to prove every performance promise ever made for Vibra-Grate Stokers.

Read these highlights from the company's *five-year* maintenance report, just released:

No unscheduled shutdowns. Savings of 919 tons of coal per year. No fly ash collector needed. No trouble with clinkering or coking coals. Peak efficiency at plant loads from 4000 lb per hour to 45,000 per hour. Load swings of 15,000 to 20,000 lb with only 3 to 4 lb variation in pressure.

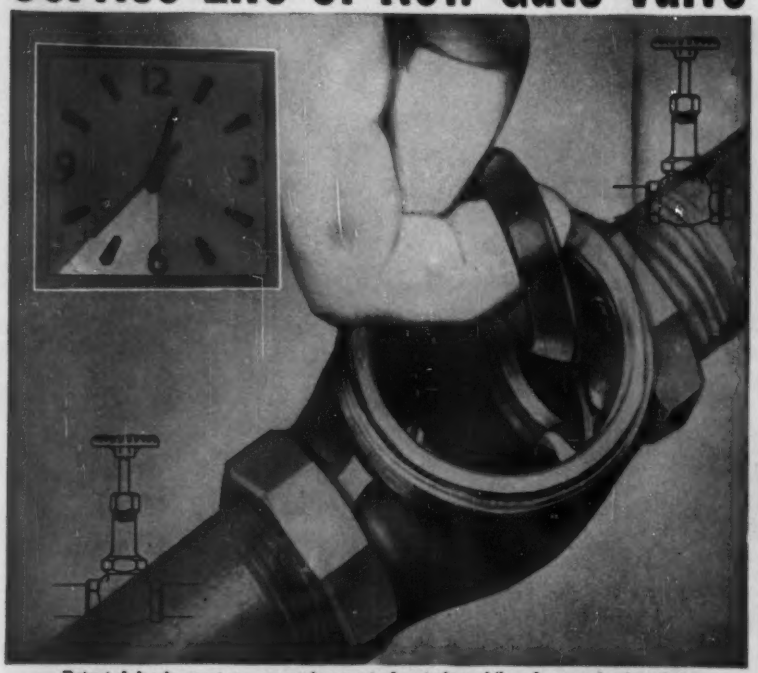
Finally, total repair costs only $188, while burning 34,962 tons of coal . . . just slightly over ½ cent per ton of coal!

The AE Vibra-Grate Stoker is the only stoker which combines the long life and low maintenance of water-cooled grates with the high efficiency of vibrating grate feed and controlled zone undergrate air. No other stoker cuts maintenance costs so drastically, gives such highs in efficiency. Get the complete design and operating story. Write today to Dept. **S-100** for our Vibra-Grate Stoker Catalog S-546-A.

AMERICAN ENGINEERING COMPANY
Wheatsheaf Lane & Sepviva St. • Philadelphia 37, Pa.

Canadian Subsidiaries: Affiliated Engineering Corporation, Ltd., Montreal, P. Q. • Bawdin Industries Ltd., Toronto, Ont.

Only 7 to 10 Minutes to Renew Service Life of New Gate Valve



Patented development assures replacement of seat ring while valve remains installed.

Without removing the valve body from the line, you replace the nickel-alloy seat rings in Fairbanks new patented Renewable Seat Ring Gate Valves. In 7 to 10 minutes, from the time the line is shut down until it is put back into operation, you have given a new service life, a new life of dependable tight closure to your valve.

Just 7 to 10 minutes of your maintenance man's time — only 7 to 10 minutes of "down-time" on your steam, water or process piping lines — and you have the equivalent of a new valve in the line. Think of the savings: where once at least one hour, under the most ideal conditions, was required to replace a gate valve in the line, the job is now accomplished in from 7 to 10 minutes.

Field tested for over two years, under all conditions from steam to corrosive liquids, the revolutionary new Fairbanks Renewable Seat Ring Bronze Gate Valve has proven completely satisfactory — absolutely dependable.

Made with either rising stem or non-rising stem construction in ½",¾",1", 1¼",1½" and 2" sizes, the Fairbanks Renewable Seat Ring Bronze Gate Valves are recommended for severe service conditions on 200 lb. steam pressure at 550 degrees F., 400 lb. water, oil or gas pressure — non-shock — lines requiring full flow and subject to frequent operation. Nickel alloy seat rings and wedge make the valves particularly tough and corrosion resistant.

YOURS ON REQUEST: Illustrated, descriptive folder gives complete information on Fairbanks Renewable Seat Ring Gate Valve with details and specifications. Yours without charge. Write today.

1. Union Bonnet removed. Retaining screw loosened with ordinary screwdriver.

2. Finger hooks inside nickel alloy seat ring. Seat ring lifts out of valve body.

3. New seat ring is inserted. Retaining screw tightened. Bonnet replaced.

THE **Fairbanks** COMPANY
393 Lafayette Street, New York 3, N. Y.
Branches:
New York 2 • Boston 10 • Pittsburgh 22 • Rome, Ga.
Valves • Trucks • Casters • Wheels • Dart & "PIC" Unions

Reports from the field

Begins on page 152

remote and self-contained air-conditioning units, a new line of compact forced-air furnaces, a packaged 50-ton air conditioner with built-in evaporative condenser, latent-storage refrigeration system, silencer for air-handling systems and a completely noiseless air-conditioning system.

Calendar of Events

Jan 11-13—Sixth National Symposium on Reliability and Quality Control. Statler-Hilton Hotel, Washington, D.C. Details: R C Mayer, 51 E 42nd St, New York 17, N. Y.

Jan 25-28 — Plant Maintenance and Engineering Show. Convention Hall, Philadelphia, Pa. Details from Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

Jan 31-Feb 5—American Institute of Electrical Engineers, Winter General Meeting. Statler-Hilton Hotel and Sheraton-Atlantic Hotel, New York, N. Y. Details from R C Mayer, 51 E 42nd St, New York 17, N. Y.

Feb 1-4—Instrument Society of America, Instrument - Automation Conferences and Exhibits. Rice Hotel, Sam Houston Coliseum, Houston, Texas. Details: ISA, 313 Sixth Ave, Pittsburgh 22, Pennsylvania.

March 6-9—5th National Electrical Industries Show, New York Coliseum, New York, N. Y. Details from Dorothy Ross, 250 W 52nd St, New York 19, N. Y.

March 6-9—American Society of Mechanical Engineers, Gas Turbine Power and Hydraulic Conference. Rice Hotel, Houston, Texas. Details from L S Dennegar, ASME, 29 W 39th St, New York 18, N. Y.

March 14-18—National Association of Corrosion Engineers, Annual Conference and 1960 Corrosion Show. Dallas, Texas. Details: R W

TRIPLE LANE TUBE LAYOUT . . .

what it is and how it IMPROVES CONDENSER OPERATING EFFICIENCY

An informative advertisement from one of the nation's most experienced condenser manufacturers

Steam condenser efficiency depends on water temperature and condition, proper maintenance procedures and many other factors. One of the most important is the design of the condenser itself—and *this* is largely a function of tube sheet design.

Triple Lane Tube Layout, a development of C.H. Wheeler Manufacturing Company of Philadelphia, is making significant contributions to condenser operating efficiencies in public utilities and industrial plants throughout the country. Figure 1 shows a C.H. Wheeler Dual Bank Surface Condenser with Triple Lane Tube Layout.

This tube sheet design permits steam to travel through three separate pathways. As a consequence steam penetrates to all condensing surfaces and utilizes to the fullest extent the condensing capabilities of the steam condenser.

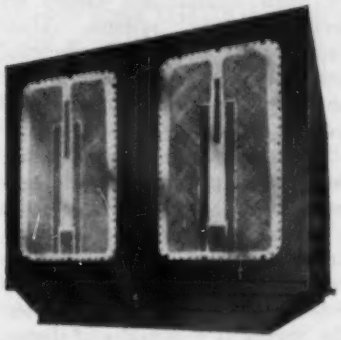


Figure 1: Typical C.H. Wheeler Condenser with Triple Lane Tube Layout.

Central location of the air cooler section, another C.H. Wheeler design feature, also improves steam travel. It reduces the depth of steam penetration and therefore reduces resistance to steam passage, achieving a new low in condenser pressure loss.

How Reverse Flow Improves Condenser Efficiency, Reduces Maintenance

Proper maintenance—keeping tubes and tube sheets free from foreign matter, algae and scale—helps keep condensers operating at peak efficiency. In some cases grass and twigs build up to a point where they would ordinarily have to be shoveled out! It is in such cases that C.H. Wheeler Reverse Flow solves time-consuming, expensive maintenance problems. Here's how it works:

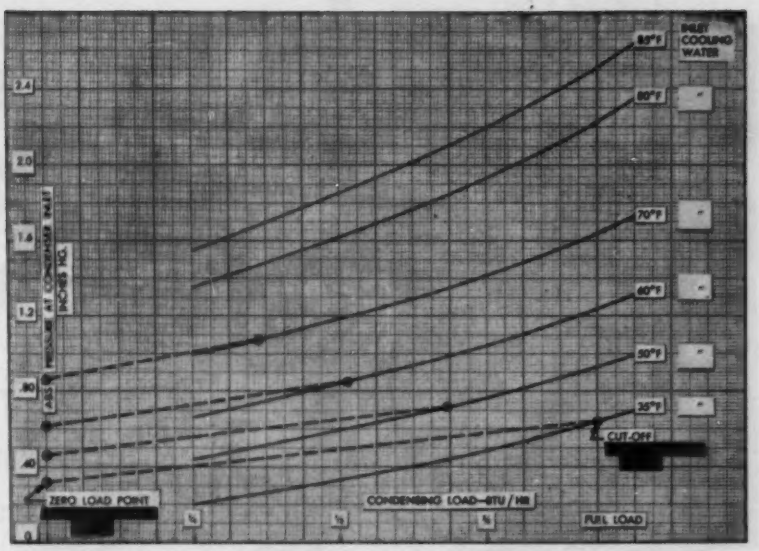


Figure 2: Typical condenser performance curves show how inlet cooling water temperature affects absolute pressure at condenser inlet at varying condensing loads. For a complimentary copy of the 38-page Condenser Handbook from which these curves are taken, write to C.H. Wheeler on your company letterhead.

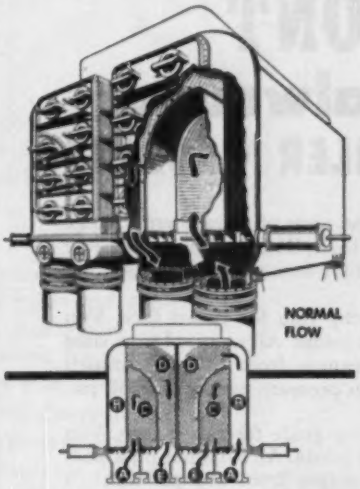


Figure 3: Diagram of C.H. Wheeler Reverse Flow which cleans tubes and sheets during full load operation.

Normal operation is shown on the left in the diagram in Figure 3. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram in Figure 3 shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

Because of more-than-half-a-century of experience in condenser design and maintenance, C.H. Wheeler is unusually well qualified to advise on condenser efficiency and maintenance problems. We invite your inquiry, whether you're concerned with condensers or with circulating and condensate pumps and other auxiliary equipment. A note on your company letterhead will receive prompt attention from us.

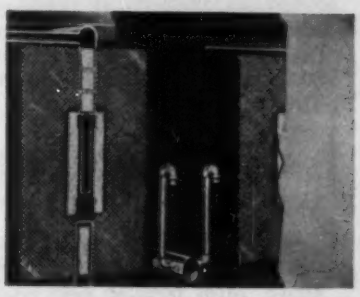


Figure 4: Central location of air cooler section in C.H. Wheeler Condensers reduces depth of steam penetration and therefore lessens resistance to steam passage, achieving a new low in pressure loss in the condenser.

C. H. WHEELER MFG. CO.

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Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components

For more facts circle 300 on Reader Service card, p 101

BELMONT
Ajax Spiralwound
FLANGE and BOILER GASKETS

No waiting for the popular types and sizes of spiralwound flange and boiler gaskets. Belmont backs their Distributors in 132 key industrial areas with stocks on hand for immediate shipment.

TYPE ER with steel centering ring for raised face, Van stone and lapped joints. All nominal pipe sizes from ½″ through 24″ in pressure ranges from 150 psi through 600 psi; and from ½″ through 12″ in pressure ranges to 2500 psi.

TYPE H with loop centering guide for raised face, Van stone and lapped joints. All nominal pipe sizes from ½″ through 24″ in pressure ranges from 150 psi through 600 psi (except 400 and 600 psi gaskets above 8″, for which services Type SR Gaskets are stocked).

TYPE MH and CR Boiler manhole gaskets in 3 pressure ranges—to 499 psi, to 999 psi and 1000 psi and above. Sizes 11″ x 15″ and 12″ x 16″ in flange widths from ¾″ to 15/16″.

TYPE A for boiler handholes and tube caps in 3 pressure ranges—to 499 psi, to 999 psi and 1000 psi and above. Most popular sizes for Babcock & Wilcox, Combustion Eng., Edgemoor, Erie City, Foster Wheeler, Heine, Keeler, Union and Vogt boilers.

•

Ask your nearest Belmont Distributor for a complete stock list. You will find him in our insert in the Packing Section of Conover-Mast Purchasing Directory.

BELMONT

The Belmont Packing & Rubber Company • Butler & Sepviva Sts., Phila. 37, Pa.

Reports from the field

Begins on page 152

Huff, NACE, 1061 M & M Building, Houston 2, Texas.

March 23-26—Electric Industry Show and Lighting Exposition sponsored by The Electrical Maintenance Engineers Association of Southern California. Shrine Exposition Hall, 700 W 32nd St., Los Angeles, California. Details: F J Tabery, 3443 South Hill St, Los Angeles 7, California.

March 29-31 — 22nd Annual Power Conference sponsored by Illinois Institute of Technology. Hotel Sherman, Chicago, Ill. Details: R A Budenholzer, Mechanical Engineering Dept, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Illinois.

ASA revises conduit and tubing standards

The American Standards Association recently revised three basic Standards for metal conduit and tubing for electrical-raceway systems. These three cover zinc-coated electrical metallic tubing used as raceways for the wires or cables of an electrical system.

Standards represent general agreement among maker, seller and user groups as to best current practice in conduit design and use. Manufacturers, consumers, technical societies and government agencies are represented on the ASA section committee. The Standards give tables of dimensions, weights, coatings and identification as well as test inspection and procedures.

General Electric will provide equipment for Ford mills

Two Ford Motor Company metal-rolling mills at the Rouge plant in Dearborn, Mich. will receive complete electrical systems from the General Electric Company. A $7 million order has been placed for delivery of shipment during the first quarter of 1960.

Producers of sheet metal for automobile bodies, the plants are mod-

Replace Complete Trim Without Removing Valve From Line!

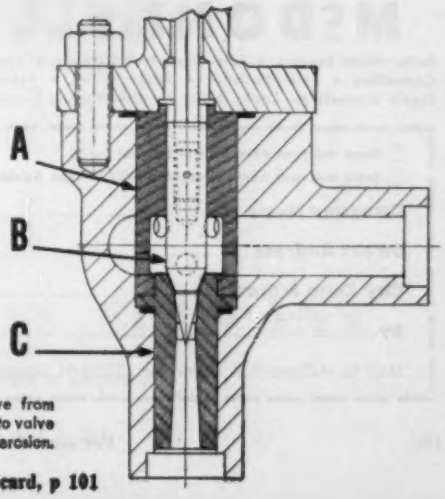
Rockwell-built Republic V-10 valves with Quick-change Trim save many hours of downtime on severe energy conversion applications with pressure drops up to 3500 lbs.

The Republic V-10 angle valve for high-pressure liquid or steam regulating services offers unique valve maintenance advantages because of its Quick-change Trim construction.

Quick-change Trim in the V-10 valve makes it possible for you to replace the valve seat, inner valve and guide in little more time than is required to dismantle and reassemble a bolted joint. No time is required for lapping the seating surfaces of the valve, since this is done in advance. *And you can make this quick trim change in minutes without removing valve from the line.* The savings to you are considerable in downtime and maintenance expense.

Republic V-10 Valves are available with either welded seat or replaceable seat, in addition to the Quick-change Trim design, with bolted or pressure seal bonnets. V-10 valve contours are designed to produce not only the desired regulating characteristics, but also to reduce erosion damage and noise as well. Precise manufacture and long-life materials make Republic regulating valves perform better, last longer, with less maintenance. For additional information, contact your nearest Republic Representative, or write to Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois. In Canada: Republic Flow Meters Canada, Ltd., Toronto. Subsidiary of Rockwell Manufacturing Company.

Rockwell-Republic V-10 regulating valve with Type J-1 positioner is designed for rugged high-pressure liquid or steam service.



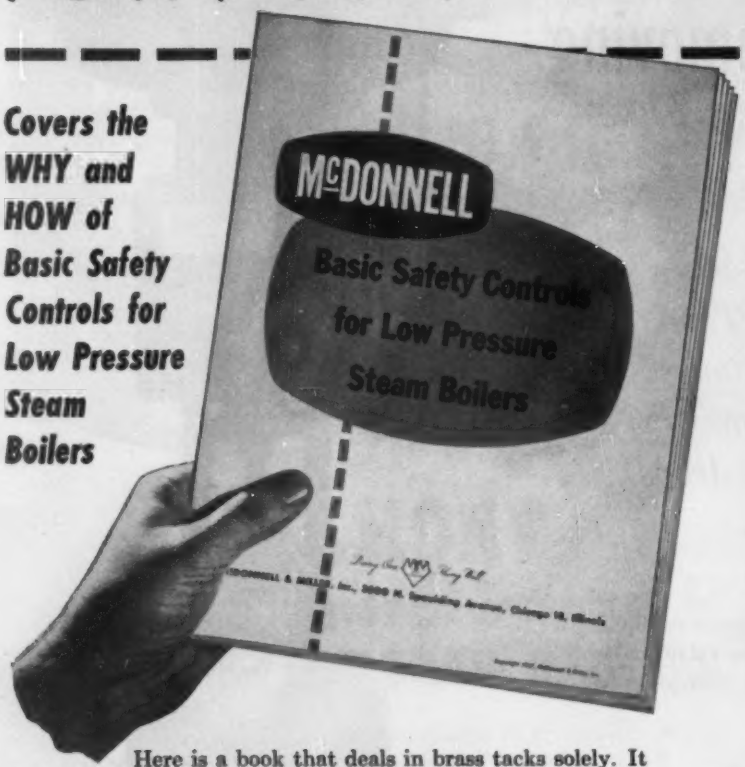
Quick-change Trim feature makes it possible to replace the seat guide (A), inner valve (B), and seat (C), without removing valve from the line. Seat extends to valve outlet to prevent body erosion.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

For more facts circle 302 on Reader Service card, p 101

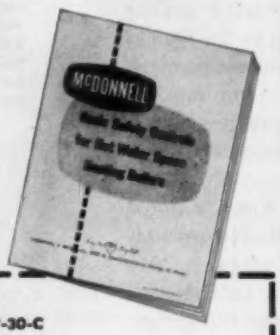
NEW BOOK THAT CAN DO A JOB FOR YOU!

Covers the WHY and HOW of Basic Safety Controls for Low Pressure Steam Boilers



Here is a book that deals in brass tacks solely. It tells its story in simple diagrams and equally simple explanation that wastes no words on product description. It sticks to fundamentals and concrete recommendations that answer practically all safety control problems encountered in the low pressure steam field. So well classified and indexed are the facts that, whatever your job, you can turn right to the most authentic way of handling it: The right product ... the correct hook-up ... the proper wiring. *Use the coupon to request your copy*, and if you do not have the earlier "hot water" booklet, request it too.

This new "Low Pressure Steam" booklet was inspired by the widely praised booklet on "Hot Water Boilers." These two companion-pieces can do a real job for you.



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Boiler Water Feeders • Low Water Fuel Cut-Offs • Pump Controllers • Flow Switches • Relief Valves • Related Liquid Controls for Tanks, Stills, Air Conditioning Systems

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Reports from the field

Begins on page 152

ernizing and expanding. Five stands of a 6-stand, 66-in. hot-strip finishing mill will be driven by new 5000-hp motors fed by individual 4000-kw rectifier power supplies. The sixth will use an existing 4000-hp motor powered by a new 4000-kw rectifier. A speed-regulator system and an automatic gage control using gage meters on three stands are included in the modernization program.

Four 5000-hp twin drives and a 1200-hp double-armature reel motor will drive a 4-stand tandem cold-strip mill. An X-ray type automatic gage control will maintain desired strip thickness. Startup is expected by fourth quarter of 1960.

Bailey Meter institutes workshop

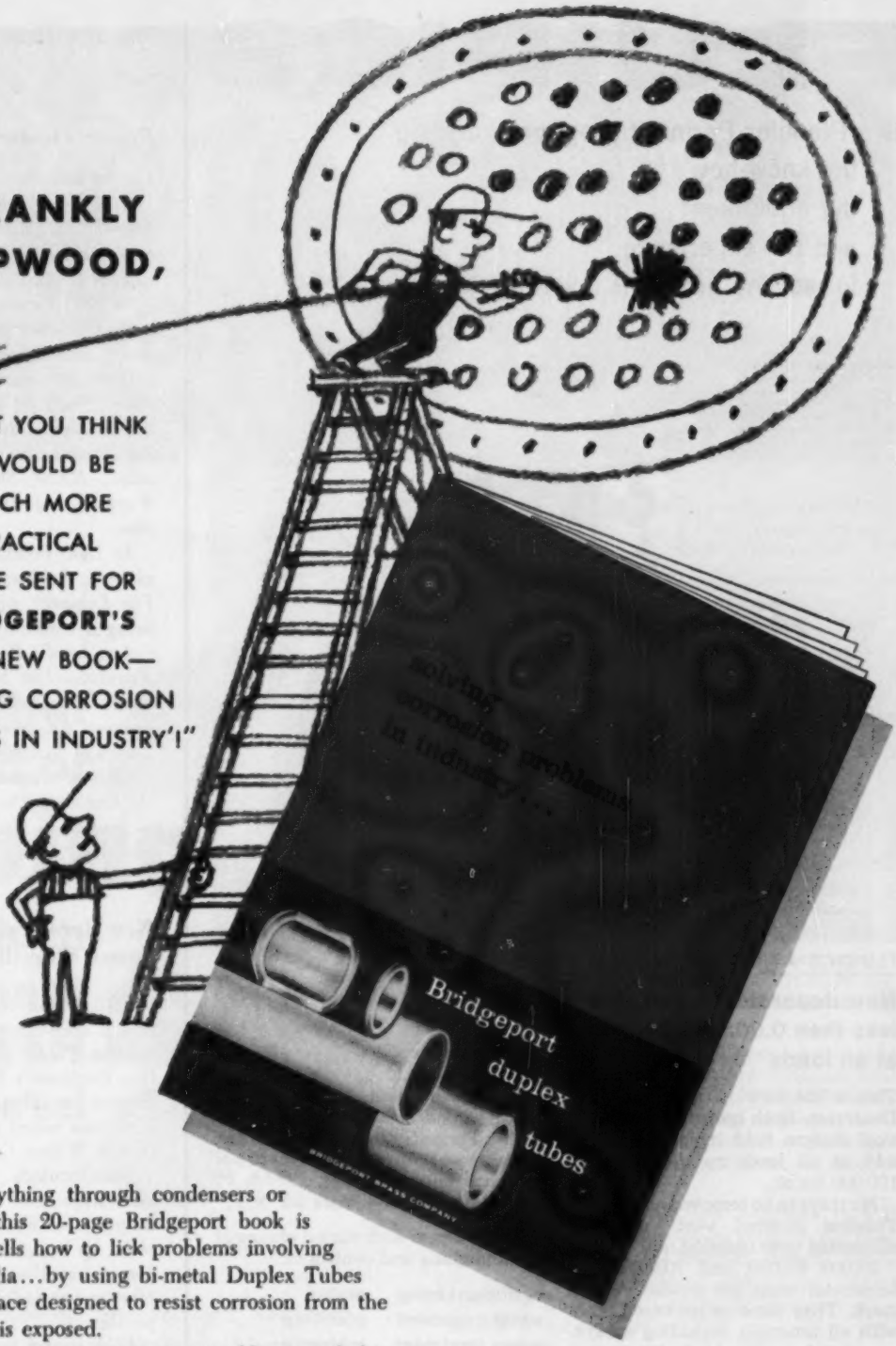
First 2-week workshop session of Bailey Meter Company's newly formed Institute of Practical Cycle Analysis took place this fall at the company's Wickliffe, Ohio plant. According to P S Dickey, president of Bailey Meter, institute will assist engineers from companies who have purchased automatic heat-cycle monitoring and test equipment in obtaining maximum benefit from its use, let engineers discuss common problems with each other and some of the top men in the fields of instrumentation, boiler and turbine design.

Workshop consisted mainly of talks and round-table discussions covering high-accuracy measurement and testing, turbine and heater characteristics and the "gain" approach to cycle analysis. Visiting engineers made calculations and studied methods of setting up computer programs, analyzed different cycles and determined cycle malfunctions from data provided.

continued

"FRANKLY HOPWOOD,

DON'T YOU THINK IT WOULD BE MUCH MORE PRACTICAL IF WE SENT FOR **BRIDGEPORT'S** FREE NEW BOOK— 'SOLVING CORROSION PROBLEMS IN INDUSTRY'!"



If you convey anything through condensers or heat exchangers, this 20-page Bridgeport book is must reading. It tells how to lick problems involving two corrosive media...by using bi-metal Duplex Tubes ...each metal surface designed to resist corrosion from the media to which it is exposed.

Each industry has its own corrosion problems, and this fact-packed book illustrates ways to solve many of them. For your personal copy, just write, on your company letterhead, to the Bridgeport Brass Company, Bridgeport 2, Connecticut. Please address Dept. 5401.

Bridgeport

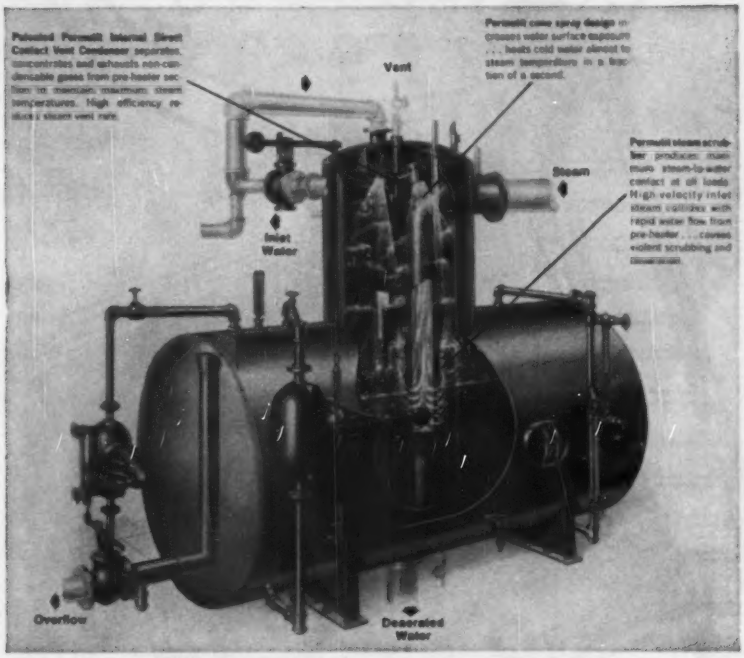
BRIDGEPORT BRASS COMPANY

Bridgeport 2, Connecticut • Sales Offices in Principal Cities

Specialists in Metals from Aluminum to Zirconium

FLUIDICS

is a Pfaudler Permutit program providing
the know-how
the equipment
and the experience
for solving problems involving fluids.



FLUIDICS AT WORK

New deaerators guarantee less than 0.005 ml/l oxygen at all loads

This is the new Permutit Type B Deaerator. Both horizontal and vertical designs hold oxygen to 0.005 ml/l at all loads up to a peak of 150,000 lbs/hr.

No trays to be removed or cleaned. Tubeless internal vent condenser eliminates tube cleaning, also.

30,000, 50,000, and 70,000-lbs/hr horizontal units are available from stock. They come as packaged units with all internals, including sprays, completely assembled. Pre-fitted float-cage and gauge-glass piping further simplify installation.

Capacities from 150,000 to as much as 3,000,000 lbs/hr are available in Permutit Type A Deaerators.

For more information, write to our Permutit Division, Dept. PO-10, 50 West 44th St., New York 36, N.Y.

Fluidics covers such varied phases of fluid handling and control as:

corrosioneering	drying
water treatment	blending
waste treatment	metering
reactions	valving
ion exchange	piping
gas analysis	pumping
agitation	storing

Whenever you have a fluid-handling problem, look to this Pfaudler Permutit FLUIDICS program for the best solution.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

Reports from the field

Begins on page 152

Power's history

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam* which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals—*Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers* and *Steam Electric Magazine.*

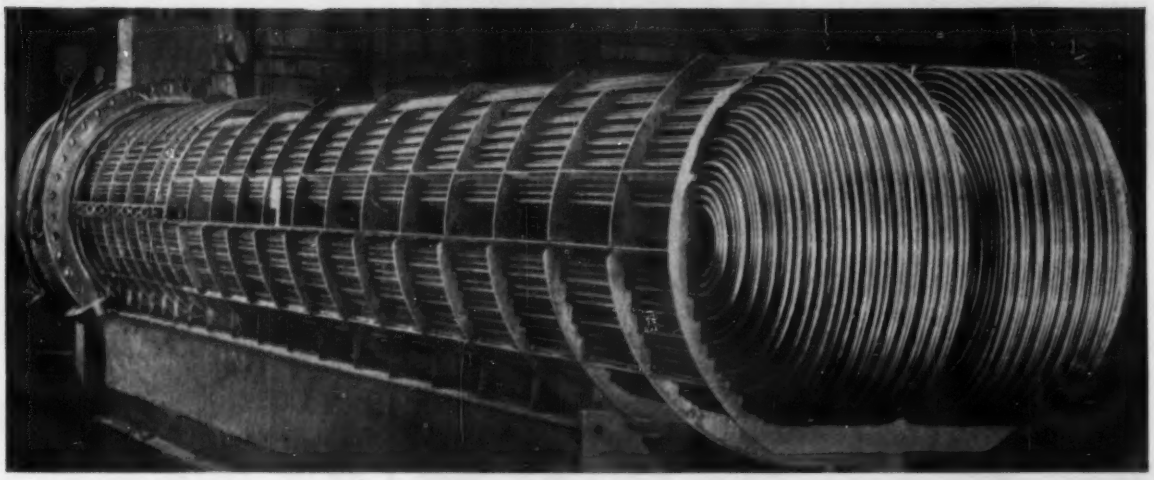
In 1908 POWER absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Steam Engineering* and *The Mechanical Engineer.* When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer.* The title was condensed to POWER in 1911. In 1951, POWER absorbed *Operating Engineer.* All rights to above titles reserved.

New Jersey utility issues $8-million contract

An $8-million contract to manufacture a once-through steam generator for the Public Service Electric and Gas Company's Sewaren Generating Station in Woodbridge Township, N. J. was issued recently to the Babcock & Wilcox Company.

Once-through method of steam generation uses a boiler resembling a long tube. Water enters at one end, picks up heat, changes to steam, becomes superheated and leaves the other end at desired pressure and temperature.

With startup in the spring of 1962, this will be the largest steam producer in utility's system, developing about 2,200,000 lb per hr at 2450 psi and 1100 F for a 342,000-kw turbine-generator. At full load the unit will burn about 450,000 gal of oil daily, enough to heat 200 average-sized homes for one year. Provision has been made for future firing with pulverized coal at 2500 tons per day.



What kind of tubing do modern heat exchangers need?

The tubes that go into today's heat exchangers must have the right combination of properties to efficiently handle today's operating conditions as well as tomorrow's higher pressures and temperatures.

There's one tubing material—Monel* nickel-copper alloy — that can give you all the properties and advantages to insure long, trouble-free service:

- **Higher design stresses.** Without increasing tube wall thicknesses, Monel tubing can be used for higher pressures. The latest revision to the ASME Boiler Code, SB-163 Table UNF-23 (nickel-copper tubing) allows an increase of approximately 5% in existing design stresses.
- **Better all-around corrosion resistance.** Monel resists corrosion by waters of all sorts.
- **High ductility.** Monel has good ductility for rolling and bending — permits unannealed tube ends. High ductility means tight rolled joints, and ease of forming hairpin bends.
- **Easy weldability.** Welding Monel alloy tubes to steel tube sheets is no problem. The alloy fuses well to form a strong, sound weld. Its coefficient of expansion is close to that of steel tube sheets.
- **Product quality.** Monel tubing for feedwater heaters is produced at Huntington Alloy Products mill with consistently close tolerances and unvarying quality.
- **Long length tubing available.** The automatic cold draw bench at Huntington Alloy Products mill makes Monel tubes *as long as 85 feet!* This enables designers to take advantage of greater heating area in the tube bundles, and to effect economies by specifying longer heaters of smaller diameters.
- **Prompt deliveries.** With new facilities in full operation, prompt deliveries of your Monel tubing requirements can be assured. Special attention will be given to retubing jobs, where prompt delivery is important. Orders are accepted on a basis of 8 week delivery.

Keep Monel alloy in mind when you design or retube a high pressure heat exchanger. For more information on Monel and other dependable high nickel alloys, write for "Standard Alloys for Special Problems."

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Trans-Canada Air Lines
Bethlehem Pacific Coast Steel Co.
International Min. & Chem. Corp.

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The Children's Hospital, Ohio
Bronx State Hospital, N. Y.
Loring AFB Hospital, Me.
Hadassah-Hebrew Medical Center, Israel

SCHOOLS & UNIVERSITIES

Rutgers University, N. J.
Hilltop Elem. School, Ohio
American River Jr. College, Cal.
Medeira High School, Ohio
Brigham Young University, Utah
Indian Hill Elem. School, Ohio
Holy Apostles School, Wisc.
Maple Park Elem. School, Ohio
Everett High School, Mich.
Avondale Elem. School, Ohio
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Blossom Hill School, Ohio

More than 130 International-LaMont High Temperature Water Generators already in operation have a total capacity exceeding THREE BILLION Btu/hr.

This unequalled acceptance underlines a significant point. It is not enough merely to heat and distribute water at temperatures to 430° F. or more. The *real* economy of HTW is in the *magnitude* of the temperature differential between boiler discharge and return water.

Making full use of the proven LaMont principles of forced recirculation, International-LaMont Generators permit temperature differentials to 200° F. or more with *no danger of thermal shock*. Here is the key to major capital and operational savings throughout the system. In addition, International-LaMont counterflow design assures optimum heat absorption and high operating efficiency.

Investigate the *true* economy of high temperature water in terms of International-LaMont Forced Recirculation Generators.

Get full details from your
INTERNATIONAL DISTRICT REPRESENTATIVE
or write for Bulletins 700 and 1000 today.

IBW BOILER BUILDERS SINCE 1886

THE INTERNATIONAL BOILER WORKS CO.

930 Spruce St. East Stroudsburg, Pa.

Steel Firebox Heating & Power Boilers
Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Generators • ASME Code Pressure Vessels & Welded Products

Manufactured and sold in Canada under agreement with CANADIAN VICKERS LTD. Montreal, P. Q.

Appointments

Corporation changes

Arcrods Corporation: H M Peterson, vice-president. **Babcock & Wilcox Co:** R A Barr, vice-president, refractories Div; J. P Craven, vice-president Boiler Div. **Bice-Burndy Ltd:** S Wolberg, G Szabad, A Thomson, E Bowyer, E F Duncan, R A Crook—directors. **B-I-F Industries, Inc:** R W Pearce, W L Sammons, vice-presidents. **Borg-Warner Corp, Ingersoll Products Div:** H A Schmeal, vice-president, treasurer, secretary; M R McLary, executive vice-president. **Cohu Electronics, Inc, Kin Tel Div:** W Shreve, director.

Fairbanks, Morse & Company: B R Eng, vice-president. **Gates Rubber Company:** F S Bosley, executive vice-president in charge of manufacturing; C H Mingle, executive vice-president. **Granberg Corporation:** R W Wetjen, vice-president and general manager. **Hammond Valve Corporation:** W C Petersen, vice-president in charge of manufacturing. **Ingersoll-Rand Company:** W T Alderson, vice-president. **I-T-E Circuit Breaker Company:** A G Bosanko, vice-president—Indoor Distribution. **Manning, Maxwell & Moore, Inc:** J F Reed, executive vice-president and member of board. **Midwest Piping Company, Inc:** N B Champ Jr, vice-president.

Milton Roy Company: E J Serfass, vice-president in charge of research and development, member of board. **Reliance Gauge Column Company:** M C Parker, A L Goellner—vice-presidents. **S & C Electric Company:** S I Lindell, vice-president in charge of research and engineering. **Triangle Conduit & Cable, Co, Inc:** R E Martin, director of research and development. **Turbocraft, Inc:** C R Crusan, president and general manager. **United Electric Coal Companies:** F F Kolbe, chairman of board.

Consultant changes

Allis - Chalmers Manufacturing Company: C R Peter, consultant; C R Martin, supervisory engineer—control dept. **Carpenter Steel Com-**

For more facts circle 307 on Reader Service card, p 101
circle 308 on Reader Service card, p 101 ➤

U. P. GENERATING COMPANY FOUND A WAY TO BE SURE OF CHOOSING THE RIGHT TURBINE OIL

They selected NONPAREIL —the only oil with life-of-turbine guarantee

Situation: In 1955, Upper Peninsula Generating Company installed a 22,000 kw General Electric turbine in its Presque Isle station. When lubricant for this turbine was chosen, U. P. management elected to install an oil with a life-of-turbine guarantee—NONPAREIL.

But that wasn't all plant management received when the decision was made to buy NONPAREIL Turbine Oil. In addition, Duane Johnson, Standard Oil lubrication specialist located in Marquette, made a complete lubrication survey of the entire plant. He provided technical service on lubrication during construction and after operations started.

What has happened: In the four years since installation, the turbine has performed satisfactorily without any lubrication difficulty. In a routine inspection a year after installation, the bearings proved to be in excellent condition. Periodically samples of the oil have been removed for analysis at Standard Oil's Whiting laboratory. The oil remains in its original excellent condition.

What you can do: Get this life-of-turbine guarantee on the turbine oil you install by specifying NONPAREIL. Call the lubrication specialist in the Standard Oil office near you anywhere in the 15 Midwest or Rocky Mountain states. Or contact **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from STANDARD *and you get it!*

Standard Oil lubrication specialist Duane Johnson (left) and station chief engineer Charles York, inspect 22,000 kw G-E turbine at Presque Isle station. On lubrication jobs of this kind Duane Johnson is well qualified to provide technical service. He has an engineering degree from the Michigan College of Mining and Technology plus 10 years' experience with Standard in this work. He has also completed Standard's Sales Engineering School.

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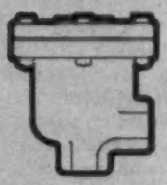

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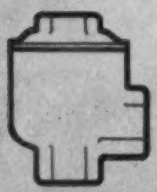

Inquire how the Cage Unit can be adapted to your present make of thermostatic traps, protecting your investment in trap bodies.

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Appointments

Begins on page 162

pany, Alloy Tube Div: Philip Coddington, consultant.

Engineer changes

Alco Products, Inc: J Gronan, chief project engineer. **Allis-Chalmers Mfg Co:** J B Cockoft, application engineer in Control Dept; R R Bukowski, assistant engineer in Nuclear Power Dept; M O Sherfey, S A Tomsic—Power Equipment Div; E J Rosecky, R D Baird—Steam Turbine Dept; W O Olmsted, application engineer in Switchgear Dept. **Anderson Electric Corp:** T L Rundlett, chief engineer.

Bailey Meter Co: P B Newell; B E Gallagher. **W I Barrows & Associates:** R C Moulenbelt, V W Seifert. **Cochrane Corp:** H Bass. **Ebasco Services Inc:** A W Peabody, supervising engineer. **Fairbanks, Morse & Co:** R L Ridgway, field engineer. **Keasbey & Mattison Co:** R E Lander, project engineer; A W Spedding, chief project engineer.

Research-Cottrell, Inc: B Gruenwald, special project engineer—mechanical dust collectors. **SKF Industries, Inc:** B M Smith, chief industrial engineer. **Singmaster & Breyer:** D J Vaccaro, chief electrical engineer. **Thermo Electric Co, Inc:** W Knesby, application engineer, Instrument Development Dept. **Whiton Machine Co:** J C Greenlees Jr, assistant chief engineer.

Obituaries

Edith Clark, retired General Electric Company, engineer, at the age of 76.

Bernard G Waring, honorary chairman and former chairman and president of the Yarnall Waring Company, on December 3 at the age of 83.

Siegfried W Spielvogel, staff engineer for Byrne Associates of New York, on December 15 at the age of 67.

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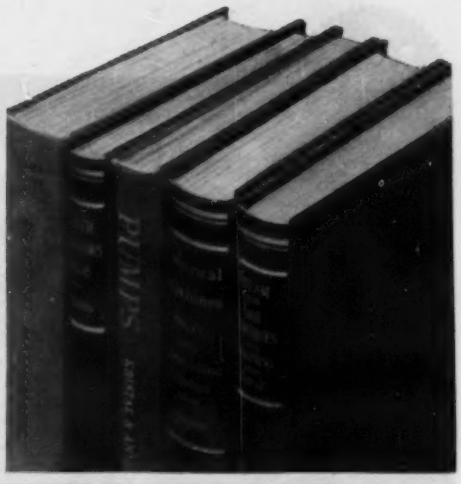

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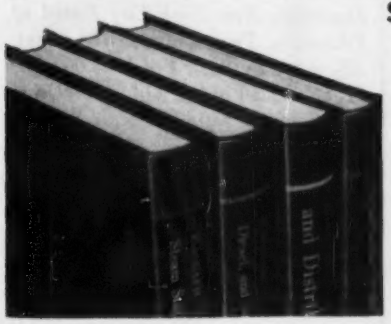

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Engineers'

Performance of Lubricating Oils, Second Edition. *By H H Zuidema. 205 pp, illust, 6 x 9, cloth, $7.00. Reinhold Publishing Company, 430 Park Avenue, New York 22, N. Y.*

Data on performance characteristics of lubricating oils under various conditions is summarized in this revision of ACS monograph no. 143. Many papers published since the first edition have been incorporated in the text. Extensive bibliographies at the ends of each chapter have been brought up to date. In addition to a subject index, bibliographies are completely indexed by the authors.

Subjects new to this edition include multigrade motor oils, fretting wear and paper chromatography.

Fuels and Lubricants. *By M Popovich and C Hering. 312 pp, 6 x 9 cloth, $8.50. John Wiley & Sons, Inc, 440 Fourth Avenue, New York 16, N.Y.*

Material from a great many sources in the fields of fuels and lubricants is brought together and summarized in this single volume. Boiler, internal combustion engine and jet fuels are covered. Rocket propellants and nuclear fuels are discussed in detail. Hydrocarbon chemistry is reviewed and a tabulation of octane numbers of many pure hydrocarbons is given.

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Standard Plant Operator's Questions and Answers. *By Steve Elonka, Associate Editor,* POWER *magazine; and Joseph F Robinson, Assistant Supervisor of Custodian Engineers, New York City Board of Education. Two volumes, 518 pages, 5⅜ x 8, 385 illust: Vol 1, $8.00; Vol 11, $8.00; 2-Vol Set, $14.95. McGraw Hill Book Co, 330 W 42 St, N.Y.C.*

This is a complete question and answer guide to fill the needs of those taking license examinations for the operation and maintenance of stationary power services.

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George Edwards

asks: Would you spend a buck to make $6?

We wouldn't be human if we didn't perk up our ears when offered a chance to "make more money" or "save more money". And with today's taxes, labor costs, etc digging deeper into each income dollar, we're eager to have a look at any legitimate scheme that'll put more on the profit side of the ledger.

In line with this, I'd like to suggest investigation of a booklet I saw recently. Published and sold by American Standards Association, 70 E 45th St, New York 17, it's a report on a survey of standardization in industry. A questionnaire asked for information on extent of company standardization, its cost, and what savings could be attributed to it. The report is frank in admitting that returns are too spotty to insure a truly representative picture. Even so, some of the findings are eye openers. Here's a sample:

Several companies indicated that, as their new standards programs get under way and as results begin to be felt, they plan to keep an eye on the financial benefits and find ways to pin down the dollars and cents. Savings reported by the companies who quoted figures ranged up to $50 per $1 spent on standards work. In terms of sales, savings ran from 0.3% to 5% with the average being close to 1%. Applying that 1% to the gross national product of more than $450 billion, there is reasonable evidence to assume that the entire American economy could save at least $4 billion a year through standardization.

In addition to answering specific questions, many companies who are getting big dividends from standardization added some voluntary comment.

A food and dairy company with 110 main manufacturing plants plus branches stated, "We have programs working in four different departments. Don't know what our total saving has been since we started standardizing, but it would amount to a substantial portion of the profit we are making."

A Southwest utility says, "We have a formal standards program with a budget of $5000. It returns an annual savings of $25,000 in engineering."

Another company (annual sales: $1295 million) spends more than $150,000 on standards work: "Typical savings include $100,000 through standard tank design and $400,000 through minimum piping." This adds up to a cool half-million bucks.

And so it goes. Without exception, all reporting companies having standardization programs are putting more dollars in the cash register than before instituting the programs.

The whole picture is not this rosy. Many companies reported that some types of standards were utilized in their operations, but, in many cases, this was more a matter of convenience than of planned economy. By and large, the survey showed that industry as a whole was making little use of standardization as a cost-cutting tool.

Maybe the big dollar figures quoted will make you back away, saying, "This isn't for me. It's fine for the big firms, but I'm just a small operator."

Well, maybe so, but don't bet on it. One company surveyed was just a 2-man outfit—and you can't be much smaller than that.

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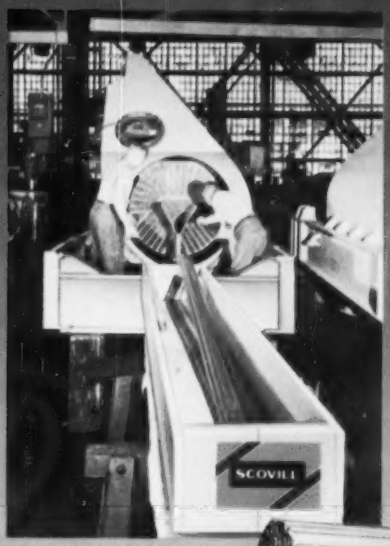

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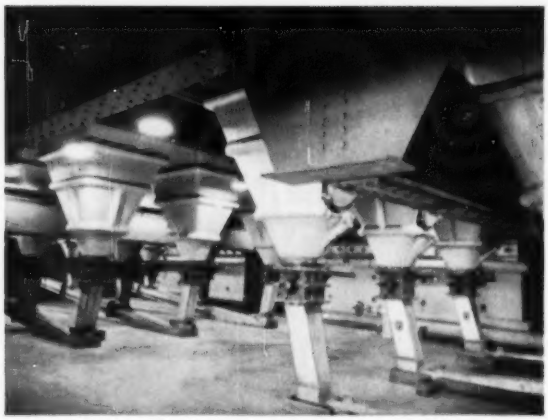
How Commonwealth Edison Turned a Fly Ash Problem Into Profit



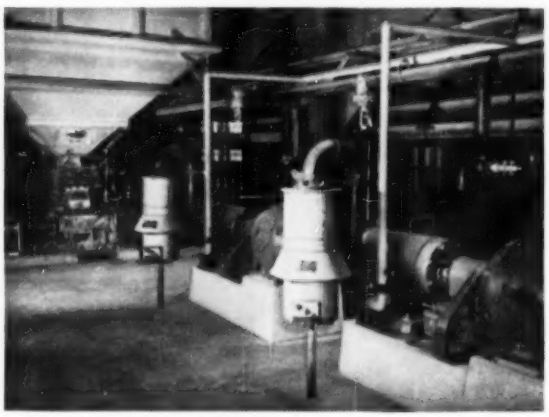
F-H AIRSLIDE FLUIDIZING CONVEYORS ANGLE DOWNWARD from precipitator hoppers, move air-activated ash to 20-ton central surge hoppers under floor. There are few moving parts.

At Commonwealth Edison's State Line Station, about 350 tons of fly ash a day had to be wet down, loaded, and trucked to suitable dumping sites.

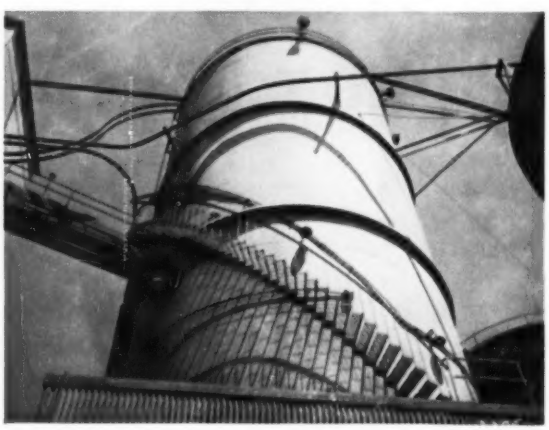
Waste becomes profit. Today, the plant burning a peak load of 5000 tons of coal daily collects dry fly ash automatically in a totally enclosed Fuller-Kinyon system. The ash is conveyed from precipitators to storage bins and silos, where it's sold as a by-product. Manpower: just three men, one at the main control panel and two bagging the ash.

Air and gravity do the work. F-H Airslide® conveyors fluidize dry fly ash by a column of low-pressure air for easy movement by gravity to central surge hoppers. Then, a Fuller-Kinyon pump under each hopper drives the ash by air through a five-inch line to storage. The system is practically maintenance-free. There are few moving parts to foul or wear out.

Large and small plants can get the benefits of Fuller-Kinyon fly ash handling. Capacities range from 100 to 8,000 cubic feet an hour. F-H Airslide and Fuller-Kinyon conveying lines can be curved to avoid beams and other obstacles. Low-pressure air provides power inexpensively and installation costs are significantly less than other types of conveying systems. Write for detailed information in Bulletin FF-49-1.



FULLER-KINYON PUMPS AND COMPRESSORS under surge hoppers propel ash to bins and silos at 20 tons an hour. Fluidized by air, the abrasive, 300°F. ash moves without injuring system.



BULK SILOS receive air-conveyed ash through Fuller-Kinyon pipe-lines. Farthest silo is 1,000 feet from pumps. Over 50% of fly ash is bagged and sold as a by-product.

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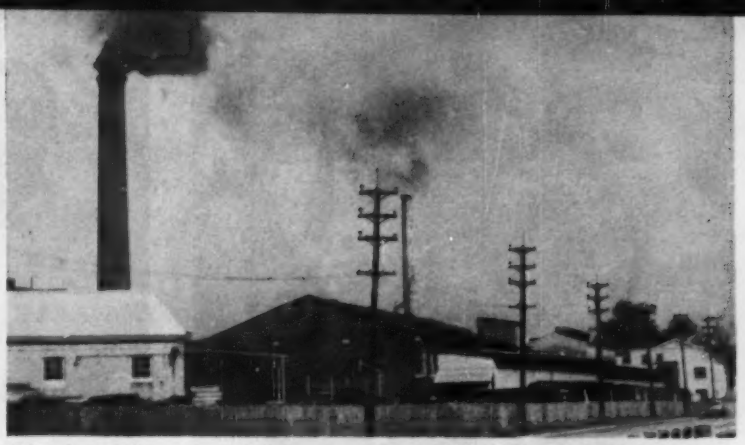


Cincinnati and neighbor communities have unique . . .

TYPICAL "SMOKER", top photo, corrected by control program. Plant cooperated by installing new boiler, dust collectors

FIRST CONTRACT signed by Cincinnati City Manager Harrell on June 20, 1957. Standing, left to right, C Surber, Lockland air-pollution official; Cincinnati's Mayor Charles P Taft; Blue Ash's Mayor Ferris

cooperative setup, show what can be done by . . .

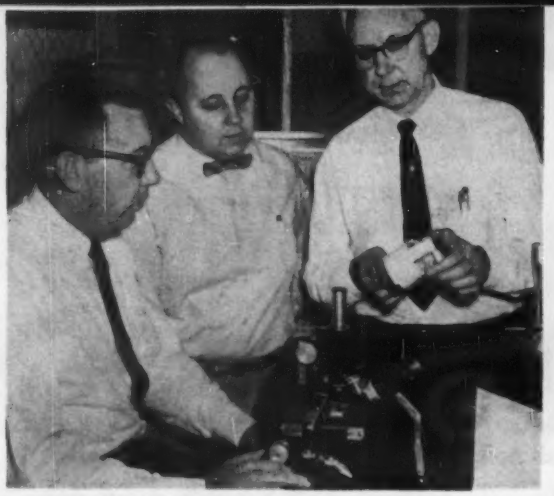
Teamwork in air-pollution control

By C W GRUBER and G A JUTZE*

On any given day a telephone may ring in the office of the Air-Pollution Control and Heating Inspection Div of Cincinnati's Dept of Safety. Caller lives in an autonomous community *beyond* Cincinnati's political boundaries and he voices a complaint against smoke, or perhaps a nauseous odor, in his neighborhood. Soon the Metropolitan Control Officer checks. He locates nuisance source—industrial plant, apartment house or residence—in the caller's community and discusses corrective measures with a responsible person. Back at the office he submits a report which is forwarded to officials of community concerned. If warranted, he'll make a return inspection after a reasonable period to see what has been done to correct the situation. Again he'll report his findings and forward to community's government. At other times, though no complaint is being investigated, the Control Officer patrols these independent communities keeping a lookout for air pollution. In short, he follows procedures identical to those used to control air-pollution *within* Cincinnati.

Obviously, procedure isn't an accidental offshoot of the city's attempts to provide its citizens with a clean atmosphere. Any autonomous community would go to law to prevent interference in its affairs by another. In a more practical vein, one community's budget wouldn't

*C W Gruber is Air-Pollution Control and Heating Engineer and G A Jutze is Metropolitan Air-Pollution Control Officer for the City of Cincinnati Dept of Safety, A-P Control and Heating Inspection



MICROSCOPIC EXAMINATION and analysis of air-pollutant sample is one technical service provided by the control program

PROPOSED INSTALLATION of a boiler in one of the member communities is examined in drawing stage by authors Jutze and Gruber

stand the strain of attempting to clean its neighbor's house. Answer, then, must be that this setup is the result of a well-laid plan. And that's exactly what it is.

To get the picture, we'll have to go back several years. Some 15 independent communities, having a combined population of 81,000, are contiguous to Cincinnati's boundaries. Several of these communities are actually surrounded, or almost completely so, by the city. Many of them are heavily industrialized.

Problem was that no matter how lustily Cincinnati attacked its own air pollution it was powerless to ward off the smoke-, gas- and fume-laden breezes wafted toward it by its neighbors. Neighbors, of course, were similarly afflicted by each other.

Clamor for a cleaner-air program arose from the communities, particularly in the Millcreek Valley area. As feeling grew more intense it occurred to Cincinnati officials that these communities, comprising some 25 sq mi north of the city, were a natural for development of a cooperative air-pollution control district.

In spring of 1956, Cincinnati's Mayor C P Taft kicked off the project. He invited all neighboring officials to meet with him and discuss the possibilities of such a plan. Meeting would indicate just how interested these communities were in a go-getting cooperative program. The meeting was a success, to put it mildly. First result was a request that Cincinnati's Air-Pollution Control Engineer meet with neighboring community officials and come up with an active plan for a Metropolitan Air-Pollution Control District.

A working plan was presented in October 1956, and met with favor all around. Next, Cincinnati allotted funds to employ a Metropolitan A-P Control Officer. City Council approved an agreement form drafted by the City Solicitor and City Engineer as the instrument by which legal negotiations could be conducted. This "contract-for-services" arrangement was only road to the cooperative plan because Ohio has no legislation allowing for direct formation of an air-pollution control district on either the county or the community level.

Estimated annual cost for the Air-Pollution Control Officer included salary, overhead, transportation and communications. Since communities' polluted air was caused by both industry and home owners and since entire population would benefit from enforcement program, it seemed only fair that each citizen should help to pay the freight. Consequently, a formula based on 5¢ per capita and 5¢ per $1000 real-estate valuation was derived.

Formal contract provided for (1) patrols to observe visible violations (2) answering citizen complaints (3) plant inspections (4) making recommendations for correcting air-polluting emissions and follow-up on the recommendations. Additional services, not specified in contract but inherent in any agreement of this kind, must certainly be inspection and approval of plans for new industrial or commercial installations in member communities. An air-quality measurement program would be necessary throughout the District.

Controversial part of the plan was ordinance regulations. Reference to this was specifically omitted from the contract agreement—it had to be a matter for decision by the individual governments. However, it was obvious that a uniform ordinance would be needed and one has been adopted.

In a nutshell, the Metropolitan Air-Pollution Program provides the specified and fringe services mentioned plus engineering consultation in connection with existing or potential air-pollution problems to all member communities. All information resulting from patrols, investigation of complaints and recommendations for correction is turned over to the community government concerned. Actual enforcement of recommendations is up to the community.

Program is quite successful. The majority, not all, of neighboring communities originally invited are participating. We believe the others will join us in due time. Program's effectiveness speaks for itself in the significant reduction in atmospheric pollution since it was instituted.

Control program uses patrol, investigation report forms

METROPOLITAN AIR POLLUTION PROGRAM
INDUSTRIAL SURVEY QUESTIONNAIRE

Date: 5/3/58

Name of Company: Huey-Broering Mfg. Co.
Address of Company: 2400 Beekman St. - 14

1. Type of Manufacturing: Machine Tools

2. Major Products	Avg. Daily Production	Days/Year
Steel Castings	25 tons	240
Mach. Tools	15 tons	"

3. Fuel Consumption:

Type	Daily Consumption
Gas	50,000 cu ft.
Oil	400 Gals

4. Raw Material Use:

Type	Avg. Daily Use	Storage
Scrapsteel	30 tons	—
Scrap iron	15 tons	—

5. Process Waste (Air Pollutants):

(Air Pollutants)	Amount/Day (If Possible)	Waste Treatment or Recovery Equipment
Grinding dust	2000 lb	Mech. tube collector
Air borne sand dust	150 lb	None
Shot blasting	400 lb	Bag house (Orlon)
Sand Handling	300 lb	Wet scrubber

6. Are there any future plans for changes in production quantities or processes, waste recovery, or other, that might change any of the above ? None

7. Plant Location Semi-industrial

8. Name and Title of Person Completing Questionnaire
Norman Huey, Plt. Supt.

9. Remarks: _____

QUESTIONNAIRE shows plant air-pollution potential level

Officials of all communities in the Metropolitan Air-Pollution Control District are consistently informed of conditions by reports submitted by the Control Officer. These forms are representative.

Questionnaire, left, gives District overall picture of plant operations and pollution potential.

Complaint investigation, center, gives story on nuisance alleged by resident of town in District.

Patrol report and map, below, submitted periodically by Control Officer shows route taken by him through the District. Notes indicate what he observed and what action he took, if any was needed. Follow-up checks are always made on severe violations.

METROPOLITAN AIR POLLUTION PROGRAM

COMPLAINT INVESTIGATION

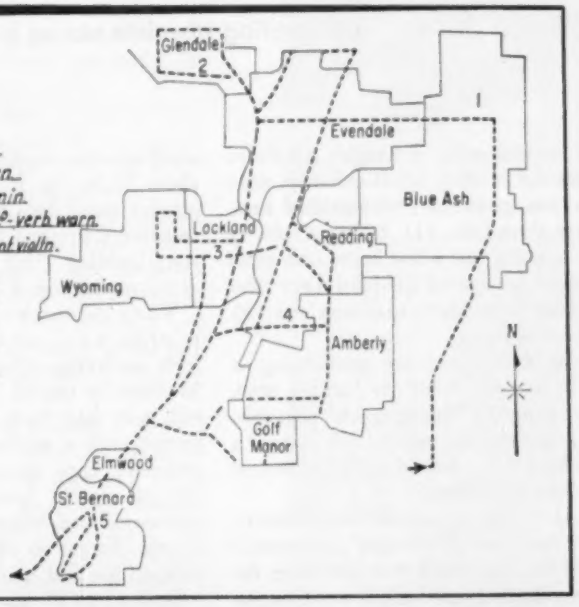
Arrived in the area at approximately 8:30 P.M. Investigated the complaint area and obtained Ringelmann dilution reading of 10 in the affected areas. Note report map listing concentration readings and odor area. The odor at this time was at nuisance level.

COMPLAINT REPORT

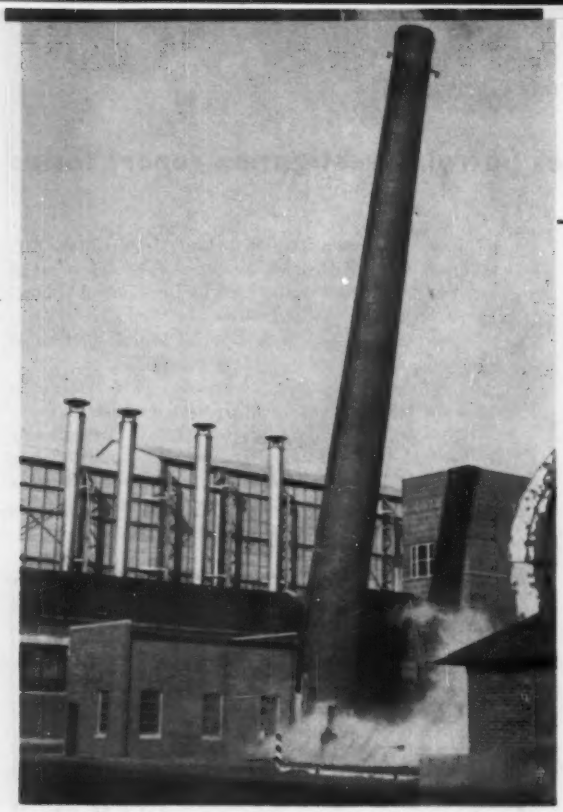
Notified Mr. Pate, Pt. Pres. of the complaint. He promised to check all process vents for proper use of masking agent and any other possible sources of odor. Time - 9:30 PM. I stayed in the area until 10:30 PM and by this time I could no longer detect cooking odors, although the odor of the masking agent being used was evident throughout the area, however, not at nuisance level.

COMPLAINTS from residents in District are fully checked

Date: 11/18/59
Time: 8:00 - 11:00 AM
Weather: Overst-Cold-Wx-N/10-19
Observations:
1. Canco-#4 U.S. (8:12 - 9:00) 7.5 min.
2. U.S. truck. - #4 o.p. - 9:22 Verb. warn.
3. Gem Ind - #4 U.S. (9:50 - 10:15) 3.5 min.
4. Amer. Drugs - sev. odor - d.c.p. - 10:40 - verb. warn.
5. Jones Fndry - #4 op. cupola (10:55) - cont. violtn.
6. _____
7. _____
8. _____
9. _____
10. _____

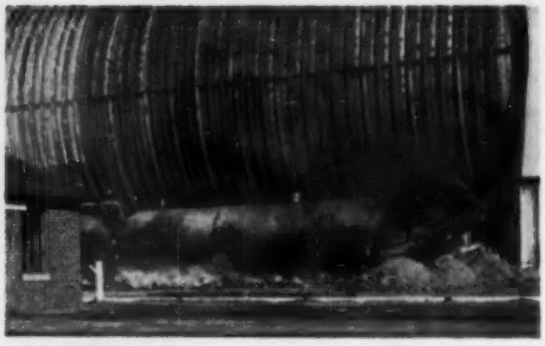


PERIODIC PATROLS are made throughout the District by Control Officer. Report shows route and findings



FALLING! After 6½ lb of dynamite explodes, this 125-ft brick stack has a narrow 36-in. margin to clear the boiler-house wall

Falling-notch principle lays the stack on the line, pinpointing its fall



DOWN! Crown strikes barrier as planned; entire length fractures. Margin for error was tight but pinpoint fall worked

Thar she goes!

By W F HALLSTEAD

Dynamiting obsolete stacks is quick, safe and economical

When heating-plant modernization at Langley Air Force Base in Virginia made the existing 125-ft chimney obsolete, the razing job was given to a dynamiting firm. Reasons for this were three-fold: (1) felling stacks by explosives is quick, requiring just a few hours instead of days (2) it's economical because of the brief work time involved and the lack of elaborate preparation and (3) it's safe—in the hands of an expert.

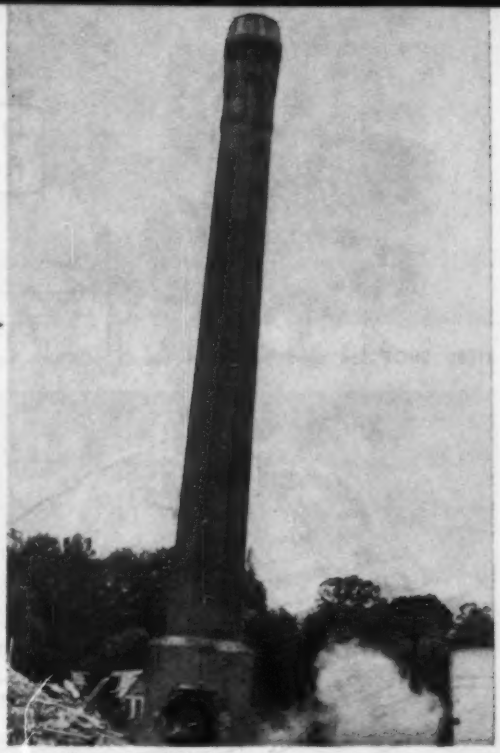
Burnbrae, Inc, a Baltimore company specializing in controlled dynamite demolition, felled the Langley stack in just one afternoon, using the "falling-notch" principle. This is the method a lumberjack uses to fell a tree: a wedge-shaped cut is blasted in side of stack in desired direction of fall, and down she comes.

Langley stack was in the ell of the boiler house. Clearance during the first part of chimney's downward swing was a mere 36 in., but that's not all. After the falling stack cleared the boiler-house wall, it was to strike ground directly between a wind-tunnel building and a small structure housing a number of delicate instruments, above right. So it was no job for an inexperienced powder man. This firm has many successful dynamite-demolition projects to its credit including razing an 8-story building. That was done in one shot in a crowded downtown section of Washington, D.C.

Where the crown of the Langley chimney was expected to strike, a soil barrier was placed to prevent the bricks from scattering. First the stack's base was drilled with 36 carefully spaced ½-in.-bore holes. Each was loaded with less than ¼-lb of 40% Du Pont Special Gelatin primed with a millisecond delay electric cap. Millisecond-delay caps spread individual firing times of the charges over a brief but important interval, holding concussion and throw of debris to a minimum because no two charges go off at precisely the same instant. Old railroad ties laid against base prevented flying debris.

Gusts up to 30 mph swept across the Base as the expert connected lead wires to his blasting machine. He waited

Telescoping principle brings her down into one neat pile of fractured rubble →



Blowing stack's base . . .

lowers her fast . . .

with nothing out of place but the dust

for a lull, then popped the dynamite. The railroad ties barely moved and just a slight tremor shook the stack. Then stack began to list. It gained speed, sailed cleanly past the boiler-house wall and crashed to the ground precisely along the predicted line of fall. Its crown struck the soil berm. Total working time: 5½ hours. Total explosive used: 6½ lb, hardly more than a handful.

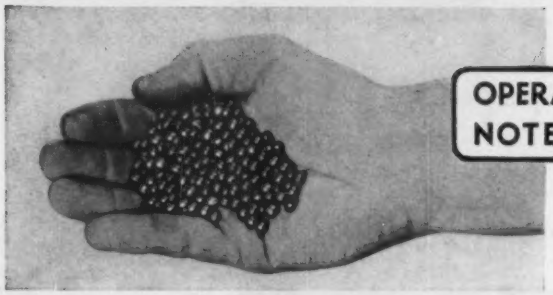
As for safety, Burnbrae's president, Jack Loizeaux, has this to say: "Standard chimney razing with jackhammers means that you've got to build scaffolding. Then you must put a crew 'way up there to strip the stack course by course. Taking the same stack down with dynamite keeps everybody's feet right on the ground."

Key to successful stack dynamiting is accuracy of fall. Burnbrae, one of the very few dynamiting firms fully insured by American companies, once dynamited a 150-ft stack at St. Johns College in Annapolis six feet from a main building on campus. Shortly after, they were awarded a 2-chimney contract at Crownsville, Md. State Hospital. First stack, a 150-footer eight ft from one of the hospital buildings, was dropped into a small cleared area. Second stack, 175-ft high and 50-ft distant, was toppled into the same windrow. Firm has felled several chimneys in a Baltimore redevelopment area and a 62-year-old brewery stack in Rossly, Va.; they razed what was reported to be the tallest stack in the East, the 250-ft chimney of the old Fleischmann Yeast Company plant northeast of Washington.

On the Fleischmann job, Loizeaux evolved a new technique. By placing charges of equal strength completely around the circumference of the towering structure, he neatly telescoped it into the available space. As the many small charges were fired, stack simply dropped straight down into a compact pile of well-fractured rubble.

None of these jobs took more than a few hours of preparation. Actual demolition time, blast-off to ground, is a matter of less than ten seconds. Technique is a fantastic timesaver, and adding to its efficiency is the fact that debris is invariably ready for immediate loading. No further fracturing is needed.

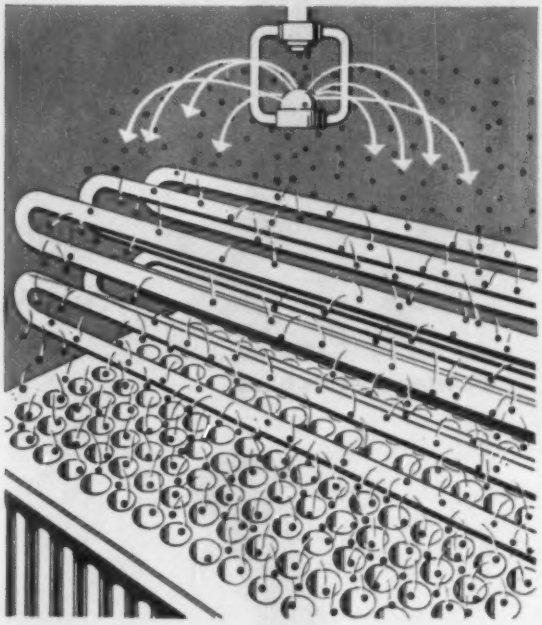
Modernization of the Langley-AFB heating plant is typical of recent plant improvements requiring stack removal. Old chimney was replaced with four 40-ft metal stacks equipped for induced-draft operation. Masonry chimney was built in 1943, but within 16 years it was obsolete and had to come down. It took an experienced blasting firm to prove once again that there is no quicker, safer or more economical way to raze a stack than with a well-placed charge of dynamite. Yep, thar she goes!



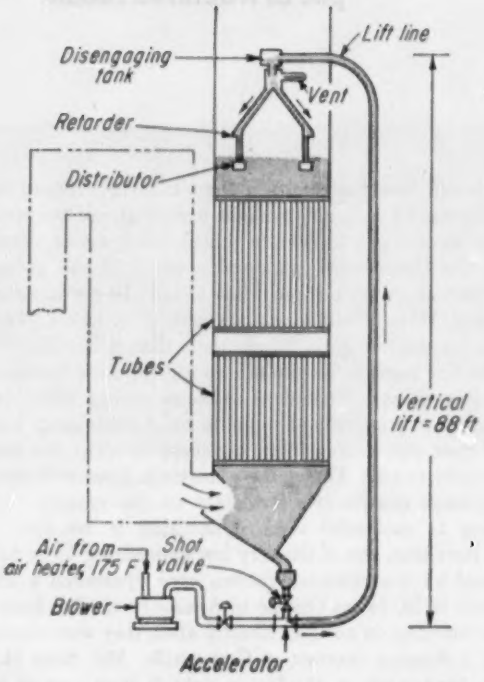
OPERATORS' NOTEBOOK **135**

You can

STEEL SHOT are used by the thousands in these systems



CLEANING is done by shot cascading over tube surfaces and ricocheting from tube to tube, removing scale particles



SYSTEM may include blower, accelerator, vertical lift, disengaging tank, retarder and distributor, depending on its job

Here's how system works

Irregularly shaped steel shot cascades over tube surfaces while boiler is in operation, ricocheting from tube to tube. This helps clean areas often impossible to reach completely by conventional methods: tubular air heaters, horizontal superheaters, reheaters and economizers. Areas tending to foul rapidly can be kept clean by increasing length of shot cycle without disturbing boiler operation.

Idea is to keep deposits off so thermal efficiency isn't affected, instead of removing deposits after efficiency is down. System is dry, so dew-point of gases isn't affected; corrosion is minimized.

Falling shot bounces against fouled areas and cascades and ricochets through vertical tubes, removing deposits in small particles. Gas stream carries away most of the ash. Heavier particles fall into hopper and recirculate with shot until broken fine enough to pass out with gases. Velocity of falling shot is enough to clean but not abrade or injure the tubes. This is most important.

System has a series of distributors, above center, which spread shot. Fallen shot is collected in a hopper below the heating surfaces, then pneumatically conveyed to top for recycling. A disengaging cartridge separates shot from lifting air, then shot passes through tank into storage.

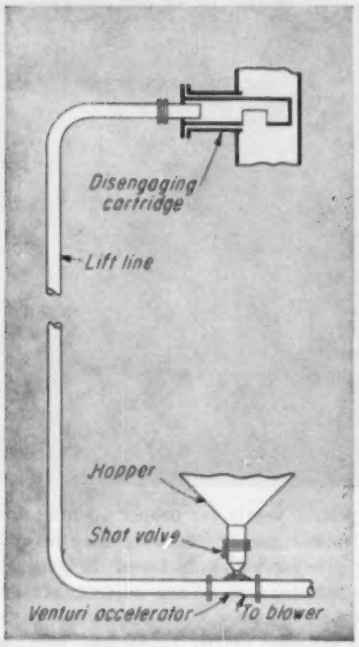
Before installing shot system, here are things to consider: Shot cleaning is restricted to *vertical* heat-exchanger sections. You must provide enough space beneath the hopper for installing the shot-cleaning pressure tank on the high-pressure lift system or shot valve and venturi accelerator on the light-phase system, right. You must have a clear space next to the boiler for a vertical run of lift line, a clear area at top for installing needed disengaging equipment.

Type of system used on a heat exchanger depends on quantity of shot needed, frequency of lifting cycle and space below hopper for installing equipment.

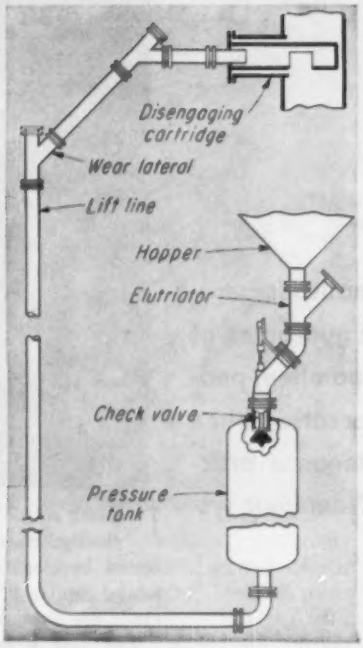
Shot cleaning has many advantages when used in boiler sections with temperatures below ash-softening temperature: (1) same quantity of shot will clean entire vertical section regardless of height (2) boiler height may be reduced by removing cavities normally needed for conventional cleaning (3) system needs no platforms or galleries around boiler (4) you may reduce aisle space between boilers (5) cleaning is often superior to usual methods. Now let's take a look at various types of shot-cleaning systems available for today's boilers. These three systems made by Diamond Power Specialty Corp.

shot-clean your boiler tubes

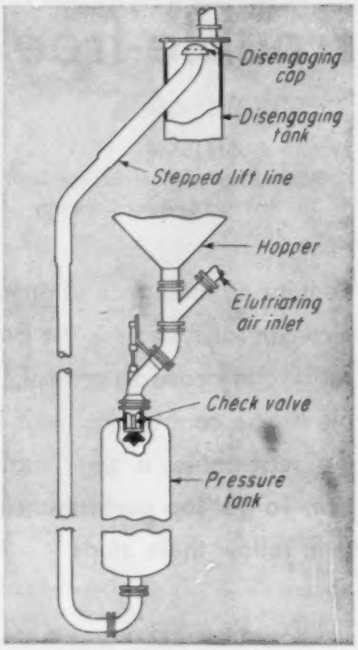
By STEVE ELONKA, Associate Editor



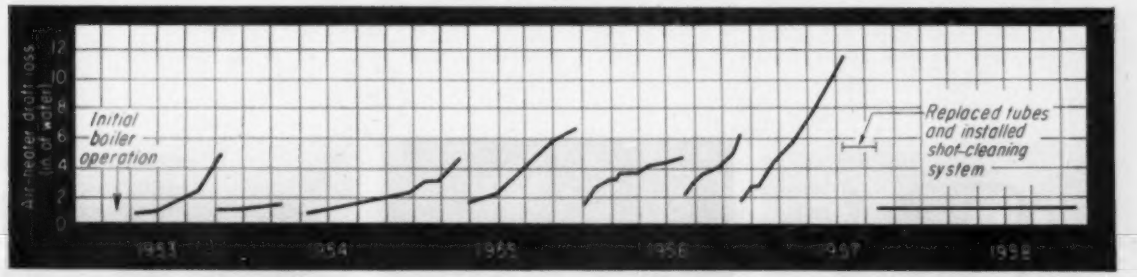
LIGHT-PHASE-LIFT system has a venturi accelerator and valve to control shot rate



PRESSURE-LIFT system has constant-diameter lift line and pressure tank as shown



HYPERFLOW-LIFT system utilizes force of high-pressure fluid in varying-taper line



DRAFT LOSS across tubular air heater increased due to plugging until cleaned with shot. Now loss is minimum and uniform

And these are various lift systems

Light-phase system feeds shot into the venturi accelerator. Venturi admits shot into gas stream at rapid initial acceleration. Shot is conveyed to disengaging tank by heavy-duty blower, connected for positive pressure or for suction lift. (Latter gives better venturi operation because of constant negative pressure at throat.) Disengaging cartridge causes shot to impinge upon a bed of shot.

Pressure-lift system has shot falling through a check valve into a pressure tank. Valve is closed at start of lifting cycle as high-pressure air, gas, steam, etc enters tank. Shot is forced into a high-pressure lift line at tank's bottom. As shot moves up pressure decreases, expanding lifting medium. Near top of line, expanded volume of lifting medium separates the shot. Slugs of shot then move at high velocity. Lifting pressure needed is between 1.25 and 1.5 psi per ft of lift, depending on length of line.

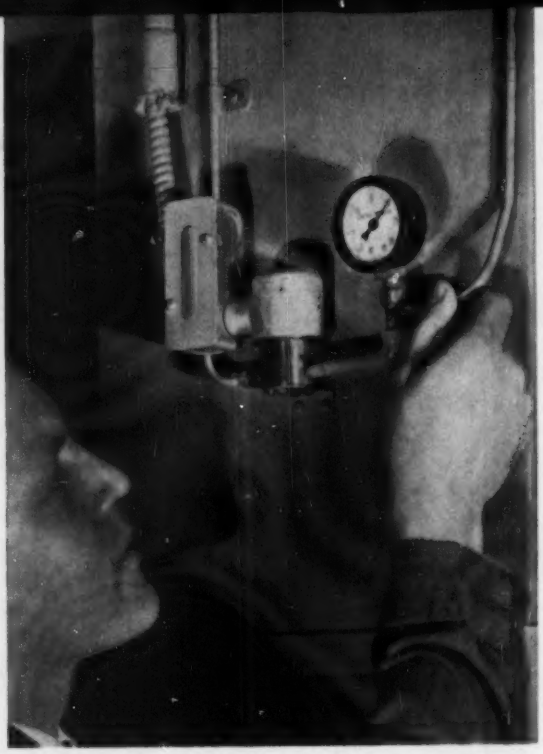
Hyperflow system, sketch, uses high-pressure air, gas, steam, etc. Shot leaving hopper falls through a check valve into pressure tank. Valve is closed only during lifting phase of shot-cleaning cycle.

Shot flows up line as a compact bed to give high flow rate with low solids velocity. Gas velocity in the line varies between 200 and 800 fpm. Lifting pressure needed is about four psi per ft of lift line. Required amount of lifting medium naturally depends upon shot rate needed to clean a particular heat exchanger.

Ten ways to keep pneumatic controls trouble-free

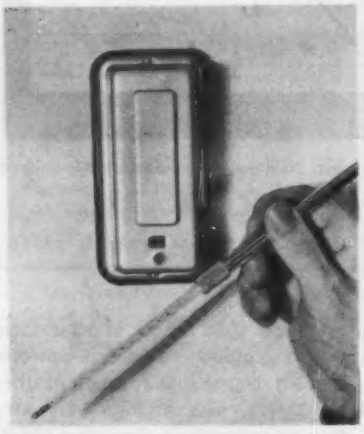
By C A GUSTAFSON
Manager, Technical Service Dept
The Powers Regulator Company

Regular maintenance of pneumatic temperature-control systems is the best guarantee of satisfactory comfort control. Too often, people blame controls for poor operation when the real cause is poor maintenance practice. To get top performance from your system, follow these steps

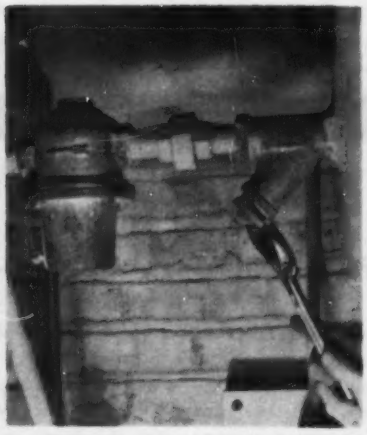


1 Check solenoid valves yearly for proper opening and closing. Some valve noise or humming may be corrected by cleaning plunger and pole faces. In general, relays require little maintenance. When adjustments are made, use a reliable 4-in.-diameter, 0- to 30-psig test gage.

For fast trouble-shooting, learn to isolate failures. Overheating or overcooling may mean control malfunction while underheating or undercooling usually does not

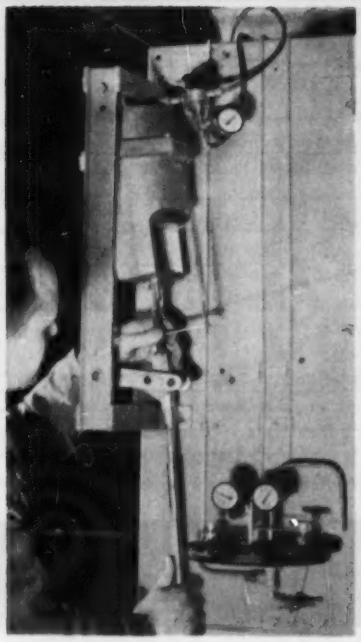


5 Check thermostats once a year with reliable thermometer. Allow five to ten minutes for thermometer to adjust to room temperature. Keep spare unit on hand to speed servicing. Prohibit control adjustments by room occupants, keep covers in place. Continual adjustment hampers control



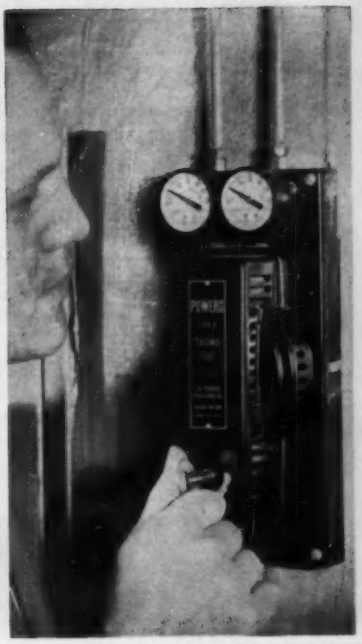
6 Clean traps and strainers on steam-heating systems at least yearly. Check operation of trap before heating season and make periodic check during operating season for excessive steam blow or valve hangup. Clogged strainers during heating season mean water problem

7 Bleed air vents on hot-water heating units twice each heating season to allow escape of trapped air. These vents usually are installed at high points in water lines. If air bubbles accumulate they can prevent water from circulating freely. Controls can't compensate for blockage

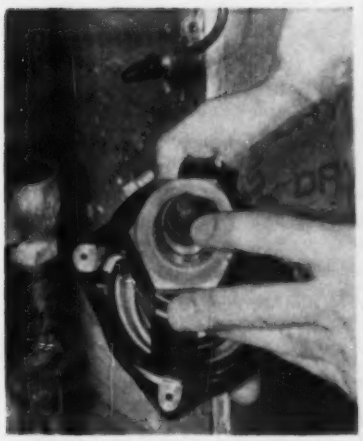


2 Check dampers and motor drives at least annually, preferably before heating season begins. Watch for binding, loose linkages, freeness of operation and proper closure. Blade and linkage bearings should be oiled with SAE-20 oil. Check rubber or metal bellows for leakage

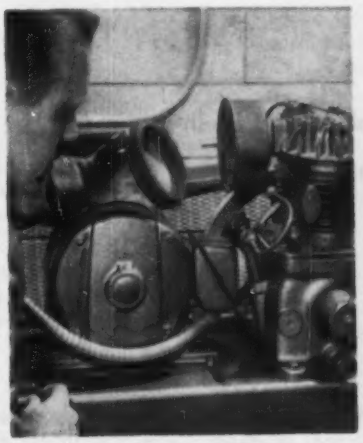
3 Lubricate stems of diaphragm valves once each heating season. To adjust lubricator, back off packing nut, tighten lubricator nut until packing nut can't be loosened further with fingers, then tighten packing nut into valve bonnet finger-tight. Check periodically for valve-stem binding



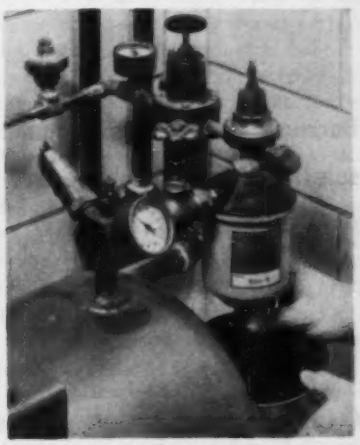
4 Check set point on mixed-air thermostats to insure adequate ventilation cooling (55 F is common). If unit fails to hold proper temperature, check calibration instructions before adjusting. Also check the temperature elements connected to thermostat for malfunction



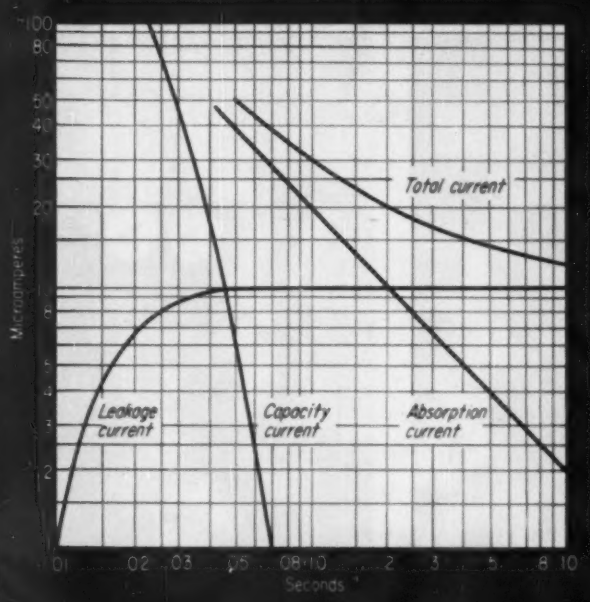
8 Check valves for tight shutoff and ease of operation. If failure occurs, remove valve and check disk and seat for foreign particles and wear. Replace worn disks immediately to prevent damage to valve seat. Lubricate valve packings with a few drops of oil and graphite each year



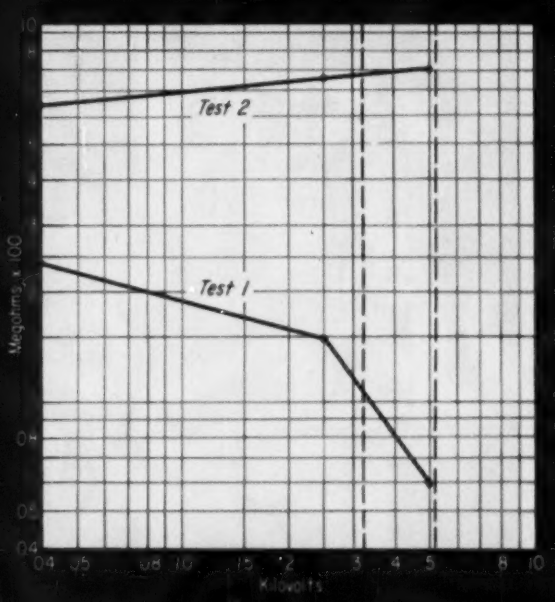
9 Service the air compressor once every three months. Remove and clean air-intake filter, lubricate compressor, check drive-belt tension. Examine commutator and brushes on single-phase motor for wear. To prevent rusting, compressor should be kept operating during the off season



10 Drain moisture, sediment from compressor air filter once a week. Check reducing valves and sediment traps for proper operation. If air pressure to equipment drops look for leaks in air lines. If tank pressure drops with line shut off, check relief-valve operation, piston compression



TEST CURRENT resulting from application of a direct voltage to insulation is the resultant of three different component currents



INSULATION of 2300-v armature shows different behavior before reconditioning (test 1) and after (test 2). Steps are one minute

Why test electrical insulation with step-voltage dc?

Because you can learn much about actual insulation condition. Here are the facts on running this test the right way

By NORMAN PEACH, Associate Editor

Of the many ways to find present condition of insulation and predict its probable future behavior, dc dielectric tests are getting most attention today. Manufacturers have put a variety of step-voltage testers on the market, some simple, others more complicated. They all produce voltage which can be selected at several values, and measure the small current flowing when the insulation is under test. Two basic designs are: (1) rotating generator in conjunction with crossed-coil ohmmeter (principle of insulation-resistance megohmmeter tester) providing up to six voltage steps and (2) h-v transformer and rectifier with a voltmeter and microammeter, giving you continuously variable voltage by varying transformer primary voltage. General requirements for test equipment are discussed in AIEE publication No. 62, *Recommended guide for making dielectric measurements in the field.* See POWER, March 1959, pp 210-211 for other tests.

Step-voltage tests are made by applying dc voltage across the insulation—connecting one polarity to the conductor and the other to ground (motor frame, cable

sheath, etc) in definite steps between minimum and maximum values, and plotting readings as megohms or microamperes. Condition of insulation is interpreted from shape of resulting curves. In sketch, near left, dotted lines represent equivalent operating voltage level ($\sqrt{2} \times 2300 = 3200$ v) and 60% of proof-test voltage, a generally accepted maximum for maintenance tests. Each voltage step was applied for one minute before recording.

Interpreting readings requires knowledge of insulation behavior under stress. This has been the subject of much careful research, adding to usefulness of dc dielectric tests. Let's look at some fundamentals.

Current observed in a test is the resultant of three component currents, *leakage, capacitance, absorption* currents.

Capacitance current results from geometric capacitance of equipment being tested. A motor, for example, has winding as one "plate" of a capacitor, the insulation as the dielectric, and the surrounding core and frame as the other "plate." In a long cable or large machine this capacitance will be considerable. Expression for capacitance current is $\epsilon^{-t/RC}$, where ϵ is natural logarithmic base, R is resistance of test circuit in ohms, C is the geometric capacitance in farads and t is time in seconds. This current decays to zero at a rate depending on R and C. In exceptional cases it may take more than a minute for current to decay to an insignificant value.

Absorption current is the component resulting from various polarizations within the insulation itself. It may be thought of as resulting from a sort of internal capacitance which causes the dielectric to charge slowly. Most important of the polarizations causing absorption current occurs at the interfaces of materials in a composite insulating structure such as mica and resin. Another polarization results from polar molecules in some types.

Decay of absorption current as the dielectric charges is expressed by At^{-n}, where A is the product of several factors determined by the equipment under test, t is time in seconds and n is absorption rate, which ordinarily ranges between zero and one.

Charging, or storage of energy, by the dielectric is a much slower process than storage of geometric capacitance energy. Discharge is also slower. Briefly shorting the insulation after a test may discharge the capacitive energy, but not the absorption energy. A supposedly discharged machine may later be found to have a dangerous charge. To be safe, keep the short circuit on the insulation for at least as long as the test voltage was applied and preferably about four times as long.

Leakage current levels off rapidly to a value V/R, far left. This current results from conduction through the insulation or over its surfaces. It is the steady-state component which remains after the capacitive and absorption currents decay to insignificant values, the most important component when evaluating insulation condition.

If leakage current is relatively small, however, the absorption current can be readily observed. With a constant voltage, a continually decreasing current (after capacitance current has disappeared) proves leakage current is negligible. Relative magnitude of absorption and leakage currents, expressed as the ratio of sum of these two currents at ten minutes to their sum at one minute, is basis of the *dielectric absorption* or time-resistance test (see POWER, July 1956, pp 118-119).

When making tests by the step-voltage method without complete discharges between steps, don't forget that total absorption current is the sum of all absorption currents resulting from all voltage increments. If absorption is still in progress at end of step 1, it continues, but also has added to it the absorption current resulting from voltage difference between step 1 and step 2. Interpretation will be easier if you keep voltage and time steps uniform.

Step-voltage tests depend on interpretation of leakage-current behavior. Theoretically, leakage current should be constant with time for any given value of applied voltage. Steady leakage current indicates that insulation can withstand the test voltage; leakage current increasing with time at a constant voltage warns that insulation may be damaged if test is continued at that voltage. Leakage current for insulation that is dry, clean and free of voids should be constant with time and should increase at each higher voltage level according to Ohm's law (as voltage is increased to higher levels the rise in current may be somewhat greater than proportionate increase in voltage). Condition of insulation under test is evaluated in terms of magnitude and rate of rise of leakage current as increasing voltages are applied across the insulation.

Insulation tests can tell you: (1) likelihood of impending failure (2) need of reconditioning to prolong life and (3) long-range trend of progressive deterioration. A *proof test* is usually conducted to determine likelihood of failure; a prescribed voltage is applied for a prescribed time, considered minimum for equipment to remain in service. The step-voltage method as a proof test has the advantage that insulation behavior can be observed and test stopped before specified proof value if rate of leakage-current change appears to be getting out of hand.

Need for reconditioning may be indicated clearly by increasing leakage current, decreasing insulation resistance (see curve for test 1). Restoration of insulation's linear-resistance curve by reconditioning the machine is clearly shown. Step-voltage method can be used at (1) voltages below rated voltage of apparatus to detect excessive moisture and dirt and (2) rated or higher voltages to detect more serious deterioration requiring more extensive reconditioning. First is particularly important for insulation in rotating machinery. Cleaning and drying indicated by a low-voltage test should be done before higher voltages are applied.

Progressive deterioration is determined by periodic tests and comparison of curves obtained across a number of tests. Interpretation depends upon observing increasing nonlinearity of the curves as the step voltage is increased, even though reconditioning measures have been taken to restore insulation characteristics.

Interpretation, of course, requires judgment and experience on the part of the person making the test, and above all an understanding of the general characteristics of insulation. For best results, tests should always be made by the same man so he can accumulate "know-how."

Plant

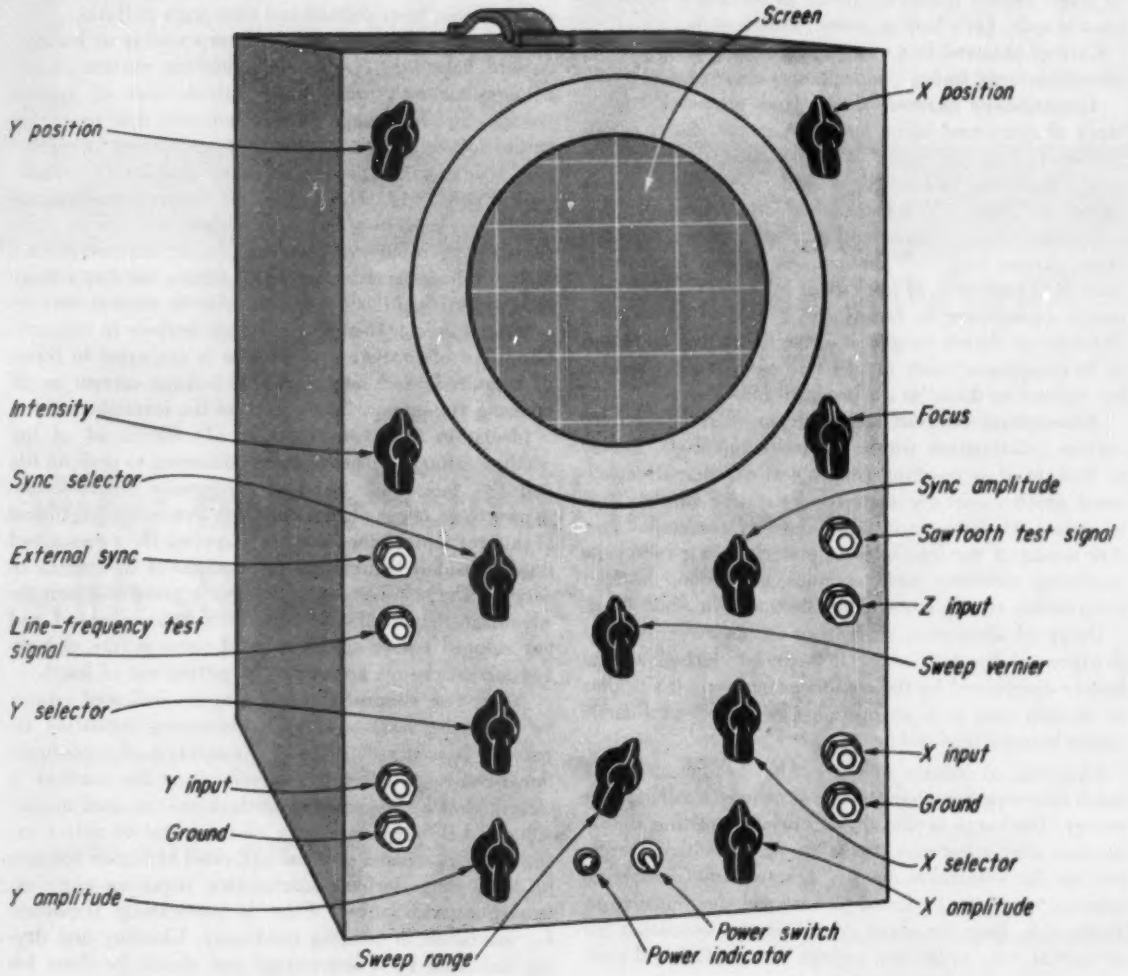
Electrical

Fact File

Oscilloscope troubleshoots electronic-control circuits

No. 43: OSCILLOSCOPE

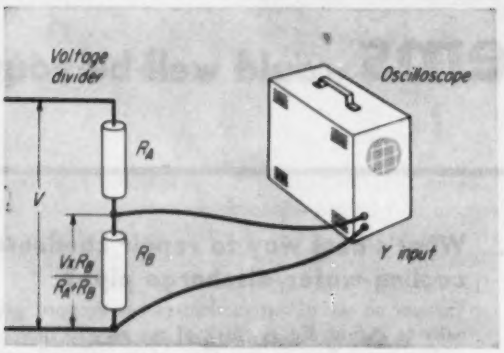
By NORMAN PEACH, Associate Editor



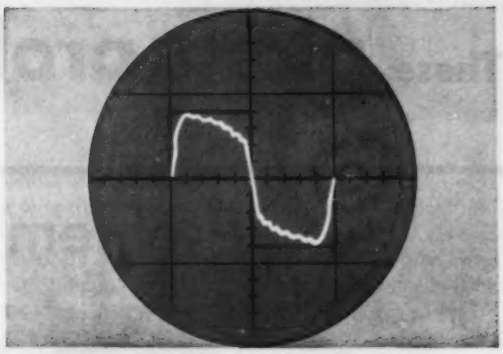
CATHODE-RAY oscilloscope is often best instrument to locate troubles in electronic-control circuits. Wave shapes on screen give you clues to cause of circuit malfunction.

Instrument is easier to operate than it looks. *X* and *Y position* knobs permit adjustment of trace's location on screen. *Focus* controls sharpness of the trace and *intensity* controls brightness so you get a good "picture". *X selector* and *X amplitude* knobs let you adjust horizontal dimensions of trace and *Y selector* and *Y amplitude* let you adjust height. *Sweep range* and *sweep vernier* are coarse and fine adjustments to input frequency—if sweep setting is ½ input frequency, two cycles will appear on screen. The pattern stands still at proper sweep setting.

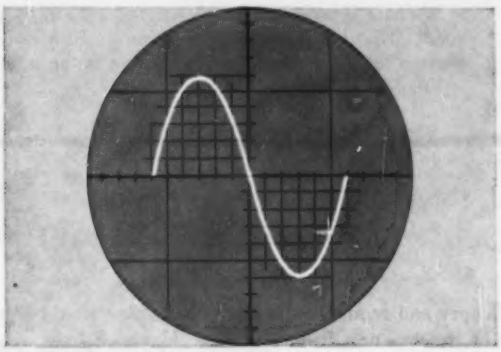
Sync selector is control for synchronizing signal keeping 'scope in time. Usually an internal or line-frequency sync signal is sufficient, but external sync-signal generator may be used. *X* and *Y* input terminals are commonly used; other terminals come in handy for specific tests. Terminals for changing connections to modify performance are usually on a panel at rear of the oscilloscope.



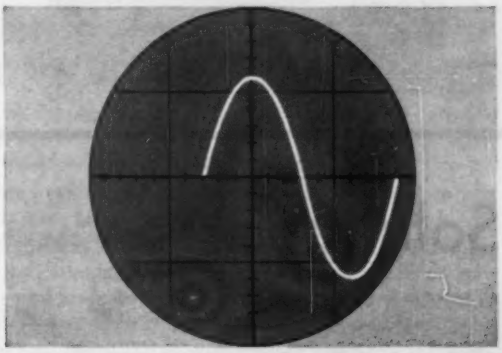
1 **INPUT SIGNAL** is usually obtained from a voltage divider made of calibrated resistors. Voltage at 'scope terminals is a definite proportion of circuit voltage. Current can be measured if R_B is a suitable shunt and R_A represents impedance of the circuit itself. Choose low-loss resistors



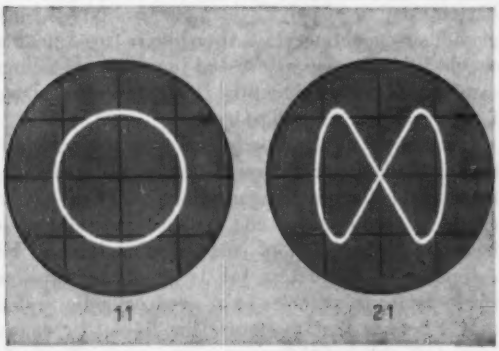
2 **CO-ORDINATE** axis is usually set to show time as distance along *X-X'* and voltage or current as a vertical or *Y-Y'* distance, positive above *X-X'* and negative below. Possible test wave is shown compared with an ideal square wave. You can observe test-wave shape while making adjustments



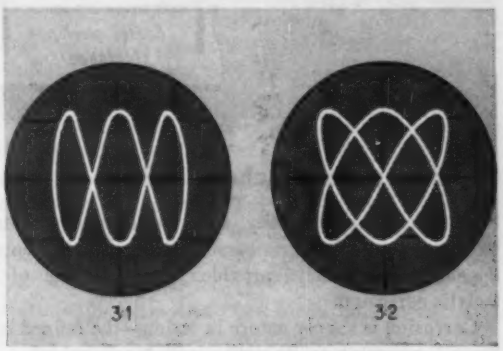
3 **CALIBRATION** of scope is done by applying wave of known shape and magnitude, such as 60-cycle line voltage. When wave is centered and adjusted as shown, each vertical division equals 1/6 line volts (peak), each horizontal division equals 1/12 of a cycle. Test signal then shows magnitude



4 **PHASE SHIFT** can be measured if *X-X'* axis is calibrated in angles and 'scope is set with a 60-cycle sweep synchronized with the line. Each horizontal division in sketch *3* represents 30 deg. Wave above is therefore lagging the sketch-*3* wave by 60 deg. Don't change voltage during the test



5 **FREQUENCY** can be determined by comparison with a known frequency within a reasonable range (say a ratio of 5 or 6 to 1). Known frequency is connected to *X-X'* terminals and unknown frequency to *Y-Y'* terminals. Resultant pattern indicates frequency ratio; you can calculate frequency

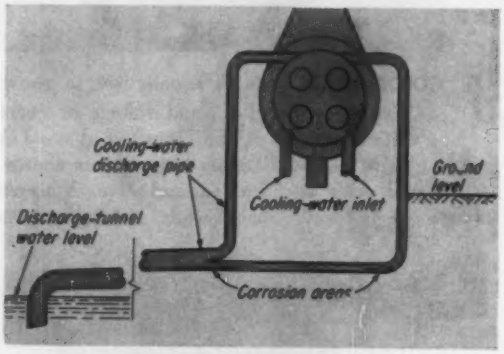


6 **LISSAJOUS FIGURES** shown on screen have a number of loops along a horizontal and vertical edge to represent freuency ratio. Example: With 3 horizontal loops and 2 vertical loops, unknown frequency is 3/2 of known frequency. If known frequency is 60 cycles, unknown is 90 cycles

These **plant problems** could well be yours...

Problem . . .

What's best way to repair condenser cooling-water discharge pipe?

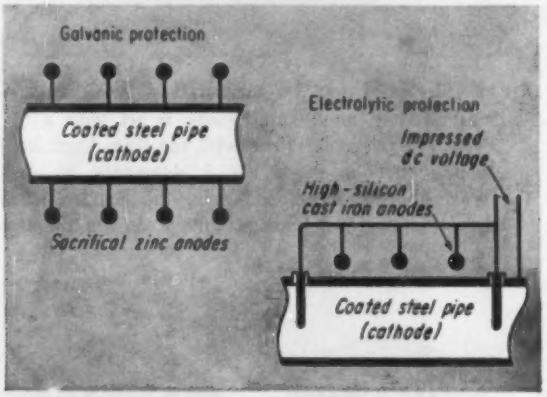


Vacuum on one of our condensers has dropped gradually to 26.5-in. Hg. A check of our records indicates cooling-water flow is now 65% of its original quantity. We found trouble was due to corrosion of cooling-water discharge pipe. Air leaked in, broke the siphon and reduced water flow rate.

Pipe was fabricated of ¼-in. mild-steel plate, asphalt coated inside and out. Unit operates with sea water for condenser cooling. Most-corroded portion lies about seven ft below ground level and five ft above sea level.

We have several questions: Why does the pipe corrode? What is the best way to repair it? How can we prevent the same thing from happening in the future? —*YL, September* POWER

Solutions . . .



Weld on patches, check soil

Salt water, low-resistivity soil, insufficiently protected steel pipe and a few ever-present stray electrical currents appear to again have provided a severe case of electrolytic corrosion.

Corrosion is simply nature in action—the refined metal, "iron", reverting to its native ore, "iron oxide".

Further examination of the condenser interior and piping will probably show some deep pitting of steel waterboxes and evidence of impingement attack in certain pipe areas. Extent and nature of both interior and exterior corrosion would have to be evaluated for a final solution.

On basis of limited information available, most satisfactory and economical way to repair pipe would be this: (1) Remove unit from operation, blank off lines, remove water, ventilate, safety check and examine interior of condenser and piping. (2) Excavate ground from around exterior of punctured pipe and other locations appearing questionable on interior inspection. Note characteristic of ground around pipe. If poor, entire line may have to be exposed. (3) Cut out and weld in patches of new steel plate in all corroded and questionable areas. (4) Clean exterior of pipe completely and then apply a built-up barrier coating of polyethylene tape or epoxy resins and glass-fiber membrane. (5) After line is tested the backfill should be clean clay or crushed limestone screenings. Be careful not to damage coating. Don't use cinders, flue dust, foundry sand or rubbish as backfill.

Installation of a properly designed galvanic or electrolytic cathodic-protection program will reduce possibility of this happening again. Sacrificial high-purity zinc anodes properly spaced and installed generally are satisfactory for protection of coated buried lines in low-resistivity soils. If coating job is good, only small areas where faults or pinholes exist need cathodic protection.

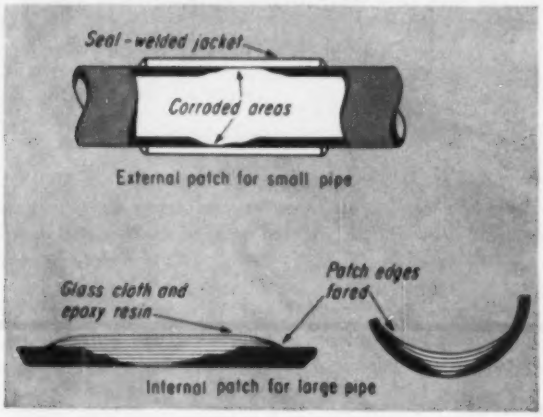
If *YL* finds that the entire line is not or cannot be protected with a satisfactory coating, some form of electrolytic system (impressed-current method) will be necessary to secure the relatively large amounts of current for protection of the more extensive areas. In this case high-silicon cast-iron anodes are generally satisfactory for chloride-containing soils. A suitable dc potential then must be impressed by means of rectifier or motor-generator set.

...Here's how Power readers would tackle them

LAWSON STEWART, Associate Editor

Choice and installation of proper galvanic or electrolytic cathodic protection should be made by an organization experienced in these problems. Only a properly designed and installed job will give the protection needed.

K N BANTHIN, *Broadview, Ill.*



Patch with epoxy resin

Problem outlined by *YL* suggests galvanic corrosion. If the condenser tubes are non-ferrous metal, with a good salt-water electrolyte, all elements are present for a galvanic cell. This being the case, corrosion rate for the pipe is further enhanced by asphalt coating.

This may not be obvious on first consideration. However it is well known that coating a pipe without leaving holidays is an expensive as well as near-impossible task. Unless extensive precautions are taken there will be minute voids in the coating, salt water will contact steel pipe and the galvanic cell is established. What's more, corrosion at holidays is accelerated because all the current that flows is concentrated at those points.

YL did not mention whether the corrosion was internal or external but I would suspect it to be both with the internal being the more severe.

Being a cooling-water line for condensing service, piping is probably of considerable diameter, say 24 in. or larger. If pipe is small, it could be jacketed with steel plate or split pipe sections welded into place (see sketch). Care should be taken to remove asphalt for welding. Then a new coating should be applied and tested to guarantee complete coverage.

If piping diameter is sufficiently large, corroded area may be cleaned and repaired by internal overlaying with glass-fiber cloth and epoxy resins. For this approach *YL* had better engage a consultant, since the field of epoxies and similar plastic materials has grown so fast it would take a long time for him to determine the best materials.

Preventing a recurrence of the corrosion may depend to some extent upon the method of repair. However, since the main piping is steel and corrosion's assumed to be galvanic, logical consideration is cathodic protection. By providing either wasting anodes or a controlled impressed opposing voltage further corrosion may be avoided.

C L BLOOM, *Westwood, N.J.*

Select proper pipe coating

Primary cause of *YL's* corrosion problems appears to be incorrect coating for operating conditions.

Other possible causes are: (1) Return pipe may be laid in a particularly corrosive wet ground or interface of brackish and soft water, or perhaps there is wastewater in ground. (2) Inside local turbulences—unlikely but possible—after the curves may pull up the coating and promote corrosion. (3) Insufficient coating may allow stray currents to ground in these areas.

After patching failed sections, select protection to prevent further corrosion. Cathodic protection is worth considering if application is economical in this case. If pipe diameter is large, inside anodes can be provided or both inside and outside areas can be protected. An efficient coating must be laid on both faces to reduce costs of protection. Neoprene compounds are efficient but expensive. For preliminary tests and application call in a consulting specialist.

ALBERT YANS, *Liege, Belgium*

Protect against erosion-corrosion

YL's condenser cooling-water lines are apparently victims of galvanic or local corrosion, probably the former. He has all the required elements for galvanic corrosion: condenser tubing as cathode, sea water as electrolyte and exposed areas of discharge pipe as anode. The fact that most of the steel pipe is protected merely accelerates corrosion at exposed points.

Location of corrosion failure suggests a second cause—local corrosion. If pipe area becomes exposed, through erosive action at the bend or faulty original coating, local corrosion could occur. This type of corrosion shows up when relative speeds of electrolyte over metal are greater at one point than another. Metal ions accumulate where speeds are lower, become cathode areas. Anodes form where relative movement is high, causing corrosion.

In either case pipe must be repaired by welding patches at corroded areas. To prevent future problems, apply epoxy resin and glass fiber to bend areas as erosion and local-corrosion shield. For galvanic protection, install a cathodic system. This job is best handled by an expert.

E E ARCHBOLD, *Bedford, N.Y.*

continued

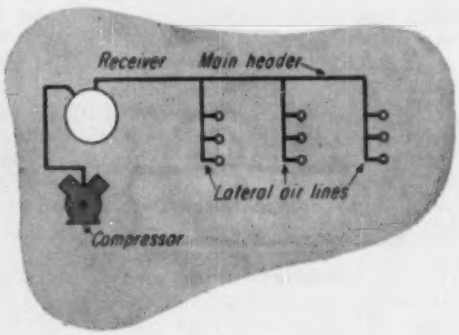
Problem . . .

How can we clean our air lines?

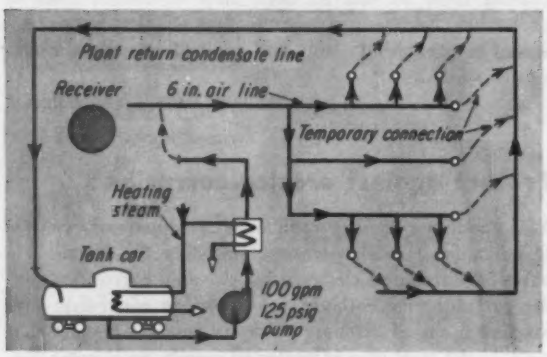
We are faced with the problem of cleaning plant compressed-air lines and would like to know the best way to remove scale, oil, etc from system. Operating pressures are medium (230-1000 psig) and high (1000-3500 psig).

Someone suggested pumping caustic solution of 1-lb lye per 18-lb cold water through the system at 10 gpm for 10 minutes, flushing lines with 1-lb soda per 10-lb cold water for 20 minutes and drying lines by blowing air through them.

We would like to hear from readers on this or any other method of cleaning.—*JOD, September* POWER



Solutions . . .



We cleaned with caustic

Cleaning and rehabilitation of air lines in a plant shut down for a period of about eight years gave us a problem similar to the one described.

At this facility the low-pressure air system (125 lb) extended from compressor station and receiver in the powerhouse to far extremities of the plant. Main header was 6 in. and the smallest branch lines ¼ in. High-pressure system (1500 lb) served a rather compact area. Investigation revealed the l-p system was contaminated with oil, plug-valve lubricant, water, rust and scale. The h-p system was only lightly contaminated.

Extent and configuration of the l-p system indicated that a circulatory flushing of main headers, cross headers, distribution laterals and equipment lines would be necessary. Further study revealed that a l-p steam condensate system nearly paralleled the air lines and with a minimum of disconnection and plugging could be used effectively as a return line for circulatory cleaning of air lines. As a bonus the return system would also be cleaned.

An 8000-gal tank car with steam coils was moved to a track near the powerhouse for use as a makeup and surge tank for the cleaning solution. A 100-gpm 125-psi pump and heat exchanger was installed with suitable temporary piping between tank and line on discharge side of air receiver. Temporary lines were also installed between condensate heater and tank car. In the plant all equipment valves were closed and then temporary lines and hoses installed between air line and condensate line to permit controlled circulation.

A 23% caustic and water mixture was made up in the tank car, heated to 180 F and circulated through the system. At first, system lost temperature but later, by use of secondary-steam-heated exchanger, a temperature of 160 F was maintained. Additional caustic was added as analysis of solution indicated.

This caustic solution was circulated for 48 hr. Nearly every outlet on the air line was connected to the return and flush circulated for two or more hr.

Afterwards the caustic solution was discharged to sewers and entire system flushed with hot water and drained. At a few places we found that we would need to weld new drain-valve connections into the low places.

In the meantime air receiver was hand cleaned and inspected. Then air lines were reconnected at the powerhouse and the entire system purged and dried with air. Sections of the air lines removed for inspection showed them free of contamination. The steam-condensate-return line was well cleaned.

H-p system was similarly cleaned but the nature of the piping necessitated numerous temporary hose hookups to secure circulatory flushing.

At this same plant we used a circulatory acid system to clean the carbonate from a number of well-water-cooled equipment jackets and heat exchangers.

K N Banthin, *Broadview, Ill.*

Use 2-stage cleaning

If *JOD* has problems with both scale and oil film a 2-stage cleaning program is called for. First step is to break down oil and grease barrier; second, acid wash to remove scale.

I have used the following program with good success to remove same type of deposit from pipelines and coolers. I fabricated a large steel mixing tank, totally enclosed, with steam coil inside and chemical-loading hatch in top. Adding a circulating pump finished unit.

First, add an industrial detergent to hot water (150 to 160 F) in the mixing tank to obtain a concentration of four ounces per gal of water. Circulate this through the lines to be cleaned for approximately half an hr, maintaining temperature by admission of steam to coil in tank, drain solution, flush system with cold water till pH of flushing return matches that of incoming water.

Second, add hot water to tank, then add sufficient inhibited 31.45% muriatic acid to produce a concentration of 12 to 15% by volume. If inhibited acid is not available the inhibitor can be purchased separately, and should be added to the solution at the rate of 1½ gal inhibitor per 100 gal solution. Circulate this through the system for about two hr, maintaining temperature by admission of steam. A hydrochloric-acid titration kit is handy for this application, as it will permit you to measure concentration of acid in water and indicate if more acid should be added to keep concentration at 12%. After two hr, or when acid concentration stops dropping, drain solution and flush system with clean water at as high a velocity as possible until pH of flushing return matches that of incoming water.

One precaution: as acid reduces the scale in the lines, hydrogen gas will be liberated. Proper measures should be taken around the pump and mixing tank so that no source of ignition is present.

J L Wise, *Reading, Pa.*

Acid cleaning is best

JOD should consult a cleaning service and I rather believe he would be advised to use acid cleaning (inhibited acid) for an air line rather than caustic. Acid is used extensively for cleaning corrosion scale from oil-process lines which I visualize as being not too different. A consultant would determine the nature of the scale and make specific recommendations for cleaning chemicals—this would seem to be basic for tackling the problem. A cleaning service will contract to do the job and their fee can be charged off to operating expense. This might be preferred to purchasing equipment requiring capitalization.

Another suggestion for *JOD* is cleaning the line with air-blown grit (sandblasting). However the problem of freeing the line of abrasive material might be greater than the primary cleaning project.

In the last analysis—why clean the line? A continuation of the same system will require additional cleaning jobs unless the compressed-air source is made oil and water free. Perhaps *JOD* should consider oil-free compressors with air dryers for a clean-air source or the installation of separators and dryers at the point of consumption for a clean-air supply.

C L Bloom, *Westwood, N. Y.*

Your January problems

How can we quiet our air-conditioning system?

We operate a small manufacturing plant on the outskirts of a residential community. Our 1-story building houses product-assembly area and general offices.

Last year we installed centralized air conditioning for the entire plant, but something went wrong! Office employees complain about rumble coming through the ducts, manufacturing personnel complain about noise of compressor mounted in their area and even plant neighbors complain—about hissing noise of our outdoor evaporative-condenser unit.

We would like to hear from Power readers who have had this problem and can suggest ways of quieting our air-conditioning system.—*BHW*

How can we schedule shift operation?

We man a small 600-hp 100-psig steam plant with one chief and three operating engineers. Steam is required continuously except during annual outage.

Under these circumstances manning charts become a headache. For normal operation we can just get by, but handling sickness or vacation period has us stumped.

Could Power readers suggest a workable shift schedule to fit our needs?—*WAG*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely **practical ideas** to help solve

This rig saved us $10,000

These photos show a novel mechanism. It was rigged from odd parts to operate on an out-of-round opening in the head cover of our old 35,000-hp hydro turbine.

Dismantling for a complete overhaul, we found that after 30 years of operation the opening or barrel in the head cover, where the turbine guide-bearing rests, had become oval. This caused shaft swing and jumpy operation, and we had to renew bearing liners every six months, a very expensive maintenance chore.

To ship the 50-ton head cover to an outside firm who had a 25-ft boring mill would have been costly and taken too much time. We'd have to split the head cover and place its sections on flatcars for shipment.

So instead we rigged up a driving unit, top photo, consisting of a speed reducer from the head of an old special lathe. Speed of reducer sheave was 13 rpm; that of shaft, 3 rpm.

Center photo shows one upper bearing, which is a bronze bushing placed in the 1x6-in. crosspiece bolted to top of head-cover opening. You can see method by which electrical current was conducted from a stationary to a rotating element. Steel disk was fastened with fiber screws. Photo also shows carbon brushes and cable carrying current to grinder motor.

A main bearing was mounted on 1x6-in. crosspieces inside the cylinder. Ball bearing was installed here to assure precision operation. Shaft size was increased from two to three in., and adjustable grinder motor mounted on an arm rotated with shaft.

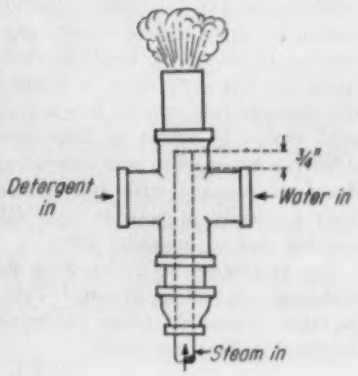
Bottom photo shows lower thrust bearing and a ball bearing mounted on its supporting brackets.

Time taken to prepare this contraption was one week; time taken to do the job, four days. Time saved on job was one month, and cold cash saved was in the neighborhood of $10,000, considering head-cover dismantling, loading, freight and so on.

You may be interested in how we established a true center. We used a machined spigot on top of the head cover. A bracket was installed to support a plumb bob on a piano wire. Then running in long inside mikes and an earphone in series, we easily determined the true center. This device won't come as much of a surprise to old erectors in the hydro field.

W Buckshee, *Shawinigan S, Que.*

Here's a jet thrower for cleaning jobs



We get good results cleaning our trucks, bulldozers and machinery parts with this device. It throws a stream of 165- to 170-F hot water and detergent mix 35 to 40 ft. When

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

operating with insufficient water it won't pull the detergent mix due to loss of vacuum; instead it pops and sputters to warn the operator.

When operating properly there's no backlash or whip. But the gadget does need at least 75 psi of steam to work right.

Hose on the left is for detergent. It's a ¾-in. x 25-ft cheap plastic hose. Open end is in a barrel of detergent mix. A ¼-in. needle valve lets operator control the detergents.

Center hose is for steam. It's a ¾-in. x 25-ft, 150-psi wire-imbedded rubber hose, pliable and easy to handle. Hose on the right carries the water supply; it's a ¾-in. x 25-ft rubber garden hose. Water pressure of 10 to 15 psi is needed for proper operation on this side.

Handle is a short length of thin-wall conduit, bent to shape and drilled at each end. One end bolts onto the boss connection of the steam hose, see photo, opposite page.

W SHAW, *Cliffwood Beach, N. J.*

How about stretching condenser tubes?

On last summer's west coast trip I ran into a neat way to extend life of condenser tubes. In the plant I visited, only inlet end of the tubes had eroded. Rest of the tubes seemed to be in good condition.

So a tube stretcher was made to screw into the thin end, while a wedge was driven into other end to keep tube from being disturbed. Then an air-operated impact tool was used to stretch each tube about six in. Stretched piece was quickly cut off with a tube cutter and the tube end rolled into the tube sheet. Entire condenser was done in this way about three years ago. As a result, it's been operating like new.

On my return to New York, I called my friends at the Condenser Service Co. They told me they first used this method back in 1935. They built special tools to stretch all the tubes of a condenser at one time. But before deciding to stretch them, they would remove sample tubes—split them up the side and open them flat. A careful inspection then indicated whether the tubes were in good enough condition to be stretched.

How long can you stretch a tube? About 50%—a 12-ft long tube was stretched to 18 ft before it snapped. Of course that's a destructive test and the tube reduces in width as it's overstretched. But a 6-in. stretch on a 12-ft tube has no bad effect.

Don't get too excited about this method of 'renewing' your tubes, though. The Condenser Service Co people tell me that they have given up this method of repairs because they seldom find a condenser with all the tubes in good enough condition to warrant a stretching operation.

STEVE ELONKA

What would you have done?

A small Colorado town got its water supply from several wells near a river. The pump motors were on a platform just above the normal water line in each well.

Each pump had a starting compensator, with three porcelain cutout bases in a metal box. And each was equipped with 200-amp renewable fuses. So far, so good.

I had been told that a motor had burned up because it had been running single phase too long. When I visited the plant, I noticed several bulged cabinet boxes and some broken cutout bases on the scrap pile. These didn't look right, had me guessing.

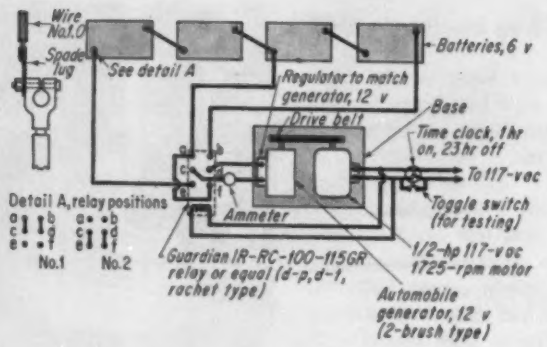
The operator anticipated my question. "Yeah," he said, "we lost one motor but it'll never happen again."

One of my eyebrows must have twitched because he hastened to explain. "I filled all them fuse cartridges with black gunpowder. Now when a fuse goes out it blows the whole damn works off the post and shuts the well down."

This is such a highly dangerous phase-failure indicator that I couldn't believe that any operator would be stupid enough to try it. What would *you* have done—besides getting out of there fast?

B SHAFER, *Denver, Colo.*

EDITOR'S NOTE: *Mr Shafer is 100% correct. I'm printing this incident only to show that truth is stranger than fiction. But I can't help but think that something besides those cabinets must have been badly bulged and warped—like that operator's head, for example.*



Novel regulated charging system for 24-v battery pack

We faced a tough problem in keeping standby diesel-electric-generator starting batteries at right level of charge. Units were in remote areas and operated unattended. In case of a commercial power failure the standby generator was supposed to start immediately.

Dry-disk rectifiers were used to charge the four 6-v batteries from commercial power. They were connected in series to provide 24 v to our diesels' starting motors. No provision was made in the original design to control charging rate. As a result, overcharging shortened battery life and lessened the dependability of automatic starting. We had to make weekly trips to the remote locations to replenish water evaporated by overcharge.

We tried to find a commercial regulator to meet our needs, but none could be located. As an alternative I devised a charging system using low-priced available equipment as shown in sketch. This system uses a 12-v generator and regulator for charging the 24-v system through a unique switching arrangement. Batteries get heavy charge when needed and reduced charge rate as they approach full charge. Also, a 5-sec delay, normally closed thermostatic relay can be used in circuit to remove relay coil from circuit after motor starts.

Electric motor and relay receive power as the time-clock contacts close. At instant power is applied, ratchet relay changes position, permitting one 12-v section of the battery pack to be charged. Rate of charge is determined by state of battery section in circuit. After a preset time the time clock disconnects power source and generator stops. When time clock repeats the cycle relay again changes position, placing other section of battery pack in charging circuit. Here again regulator provides only rate of charge needed. Cycle of 1-hr on and 23-hr off is optional and may be altered to fit individual need.

Mount motor, generator, regulator, time clock, ammeter, toggle switch and relay on ¾-in. plywood base. Enclose relay in a metal box. Be sure to use No. 10 stranded wire for 12-v circuit. Use No. 14 wire in conduit for the 117-v circuit.

J G SHANHOLTZER, *Minneapolis, Minn.*

Did you know . . .

that license requirements for stationary engineers in the U.S. and Canada and those for marine engineers have been surveyed? They now fill 57 pages of the new McGraw-Hill library *Standard Plant Operator's Q & A.*

My biggest boner . . .

One of the costliest boners that I have ever seen happened while I was a boiler inspector for an insurance firm in Philadelphia.

An old chemical plant had a Hrt boiler for process steam. Because very little of the condensate returned to the boiler, considerable raw makeup water had to be used. That naturally called for large amounts of chemicals for treating the raw water.

Compound tank was about 10-ft above the feed pump, with its outlet hooked into the suction side of the pump. To charge the tank, operator would crawl up the ladder and dump a bucket of compound into the open tank. This was done about once every twelve hours.

Evidently the suction line got plugged from the soda ash and phosphate compound dumped into the tank, so the dose was increased by the operator. But he didn't bother to look over the rim of the tank to see if the compound was leaving the tank.

The boiler naturally started to scale. After about three days the plugged line cleared by itself and overloaded the boiler with compound. Result was that for the next few days chunks of scale formed where compound settled on the lower shell. This caused bulged sheets and leaky seams.

When I inspected the boiler, the daily boiler-water tests in the log book and the bulged sheets and leaky seams told me the story at one horrified glance. I explained the probable cause to the general manager. But he just couldn't understand why they had trouble since the operator did dump in the chemicals at regular periods.

To prevent damaging the *new* boiler, I had the chemical tank lowered and a light placed above. Since then I've made sure that chemicals fed into condensate systems get into the boiler.

J MCDONNEL, *Boston, Mass.*

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Power System Dispatcher. Technical education, age 28 to 40, to dispatch large generating plant loading and 1300 mile transmission system in southwest United States. Plants and transmission system built since 1950. Minimum of five years experience of dispatching work. Send resume of education, experience and salary requirements to P-2940, Power.

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Sales Manager—Fans. Manufacturer of fans looking for M.E. experienced all phases mechanical draft fan design and selling for administrative position with unlimited opportunities for salary and management growth. Send resume and salary requirements. P-2950, Power.

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Help Wanted—Man for Result's Department. Age 20-30. High school graduate with two years college or equivalent, power plant experience. Necessary training will be given man selected. Write P.O. Box 127, Chamois, Missouri.

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H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	4000/2300	G.E.	1200
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
400	2300/440	G.E.	ATI	720
300	440/220	G.E.	TS	450
300	2300/440	G.E.	TS	1200
200	440	G.E.	TS	600
150	440/220	Whse.	G	1200
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2300/4000	Elliott	SC	1800
400	2300	G.E.	FT	3560
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/440	G.E.	sEDP	1200
300	2300/4000	Cont'l.	Spl.-Prf.	720
300	2300/440	G.E.	KT	600
250	2300/4000	G.E.	K	720
200	2300	G.E.	KT	1800
200	2200	Cont.	TEFC	3600
150	440	Whse	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2300/440		KT	600
150	2200/440	G.E.	FT	1200
125	2300/440	G.E.	K	600
100(2)	4000/2300	L. Allis.	OX	1200
100	2300	Cont'l.	TEFC	3600
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1000 Amp., DA-50, Whse., 600 V., Air
1—600 Amp., Al. Chal., 15 KV, Outdoor
6— 600 Amp., R. Smith, 7.5 KV, Hel. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	800
60/75	230	G.E. (new)	CD	500/1500
90	230	G.E.	CD	1750
50	220	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input— AC	Motor Type	Output V.— DC
300	Whse.	4150/480	Syn.	250/125
150	G.E.	440/220	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
100	G.E.	2300/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	250/120
70	El. Dyn.	440	Sq. Ca.	70
65	G. E. B	2300/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al Ch. 2400/4160Y—460 volts, 3 ph.
3—500 kva, G.E., 13800—240/480 V.
1—300 kva, Mel., 13,800—2300 V.
3—333 kva, G.E., 12,000—2400 V.
3—333 kva, G.E., 2400—240/120 V.
2—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E. 4150—480/240 V.
3—167 kva, Whse., 4150—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

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3—37½ kva, 1800 R, 220 V 3/60, Cont'l., 6 cyl.

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Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
3	750	G.E.	K	1	4000-120/240
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/3820Y/120/240
3	250	West.		1	2300/4000-230/460
3	200	G.E.	H8W2F	1	2400/4160-240/480
2	200	Amer.	CC	1	4160/7200-240/480
6	100	West.	Hypersil		2400/4160-120/240
3	75	G.E.	KF	1	2400/4160-120/240
3	50	G.E.	H	1	2400/4160-240/120
1	50	Amer.	Abestol	3	4160-120/208Y
4	25	West.	Hypersil	1	2400/4160-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 220V.
1	75	G.E.	1200	125	2300/4160 Syn.
1	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	200	G.E.	1200	250	2300/4160Y SR
1	200	G.E.	1200	250	440 Syn.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Westghe 3/60/480 —1200
1—Wisconsin Gas (Air) PE-90 7.5 KVA Master 1 or 3/120—3200 r.p.m.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	600	CW	220/440
1	60	G.E.	1800	MT	220
1	60	G.E.	900	MT546	440
1	75	G.E.	600	IM	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-BW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	250	West.	1800	CW	2300
1	450	West.	1800	CW-4-30-9,	220 or 440
1	500	G.E.	450	MT	2300
1	500	G.E.	1200	M269Z 2300/4160Y	

D. C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	350	G.E.	1200	Pedestal
1	92	West.	425/1000	SK 113
1	30	G.E.	1750	173 FR
1	30	West.	800/1400	SK-4G1542

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis. Chalmers, 2300/4160Y
1—275 HP, 1150 RPM G.E. Type KT 5505H8 2200V
2—200 HP, 1790 RPM, G.E. Elec. KP, TEFC, 2300V
1—100 HP, 1775 RPM G.E. KTP-543 3 ph 60-440V.

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100 HP 900 RPM G.E. Fem BL 2200 V.
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150 HP 1800 RPM G.E. Type TS 220 V.
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35,000#/hr, 285 PSI, 577°F

GENERATOR SETS

11—1250 KVA Natural Gas Engine Sets 3/60/2400/4160 with switch gear
(can be seen running)
1—500 KW Condensing 200 PSI Turbine
1—500 KW G.E. Non Condensing 265 PSI, 0-10# BP Turbo Generator

TRANSFORMERS

1—6000 KVA 3/60/44,000—4160 Substation
1— 750 KVA 3/60/2400/4160 Y—480
3— 333 KVA 1/60/2400/4160 Y—480

A. C. MOTORS — 3 ph. 60 Cy.

Qu.	HP	Make	Type		Speed	Volt
1	2000	A.C.	ANW		1750	2300
2	350	A.C.	AZZ	TEFC X.P.	3600	2300
1	250	Cont.	NP	TEFC X.P.	720	2300
1	200	G.E.	KF	TEFC X.P.	3600	2300
1	125	Cont.	NP	TEFC X.P.	3600	2300
1	125	G.E.	KF	TEFC X.P.	1800	2300
3	100	G.E.	K	TEFC X.P.	1800	440
1	150	West.	CW	Slip Ring	1800	440
3	75	West.	CW	Slip Ring	1800	440
3	30	West.	CW	Slip Ring	1200	440

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PUMPS

10 MAIN FEED PUMPS

PUMP: Ingersoll-Rand — size 5" — three stage — capacity 300 GPM @ 750# discharge pressure. B.H.P 330 — 5000 RPM. *TURBINE:* Worthington-Moore — design pressure 575#/sq. inch — non-condensing — back pressure 20# — 5000 RPM — 330 B.H.P.

GEARED TURBINE-DRIVEN MAIN FEED BOOSTER PUMPS

PUMP: Mfg. by Buffalo Pump Co. — vertical single stage — capacity 550 GPM — 30# discharge — 8" suction — 5" discharge. *TURBINE:* 1 stage impulse — type Y-W — vertical — design steam pressure 575# — back pressure 20# — 12.5 HP — 5500/1730 RPM — mfg by Terry Steam Turbine Co.

2 MAIN FEED BOOSTER PUMPS

Same as geared turbine driven main feed booster pumps above, but with 14.5 HP 440/3/60 AC Star motor & Ward Leonard control. Across-the-line starter with pushbutton.

8 GEARED TURBINE-DRIVEN VERTICAL CONDENSATE PUMPS

PUMP: Main condensate 2-stage vertical pump — mfg by Buffalo Pump Co. *Capacity:* 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM — 22.5 BHP — 9" suction — 4" discharge. *TURBINE:* Single stage — 575# working pressure — 20#/sq. inch back pressure — 22.5 HP — 5360/1150 RPM — Mfg. by Terry Turbine Co.

2 AUX. FEED BOOSTER PUMPS

PUMP: Vertical — mfg by Buffalo Pump Co. — 200 GPM — 30# discharge pressure. *MOTOR:* 7.36 HP — 1800 RPM — 440/3/60 — Star motor, with control.

BRONZE RECIPROCATING STANDBY FEED PUMPS

11 x 8 x 18 — mfg by M. T. Davidson Co. — vertical simplex — capacity 180 GPM — 800 900# discharge pressure — 575# working pressure.

4 TURBINE-DRIVEN FIRE AND FLUSHING SERVICE PUMPS

PUMP: Worthington — horizontal centrifugal. *Fire Service:* 750 GPM capacity — 150 PSI discharge pressure — 3500 RPM. *TURBINE:* single impulse — type B-20 — mfg by B. F. Sturtevant — design steam pressure 575# per sq. inch non-condensing. Back pressure 15# — B.H.P. 80/90.

3 GEARED TURBINE-DRIVEN MAIN CIRCULATING PUMPS

PUMP: Mfg. by Worthington Pump & Machinery Co. — 28" type — vertical single stage — bronze. *Capacity:* 28,000 GPM — discharge pressure 13.5# — 600 RPM — 267 BHP — 28" suction — 28" discharge — 8.5:1 gear ratio. *TURBINE:* single impulse — vertical type — 575# design steam pressure non-condensing — back pressure 15#/sq. inch RPM 5100 pinion — 600 gear. Reduction gear ratio 8.5:1 — 267 BHP — mfg by B. F. Sturtevant.

3 MOTOR DRIVEN MAIN CONDENSATE PUMPS

Mfg. by Buffalo Pump Co. — vertical 2-stage — 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM. *Motor Data:* 25 HP — 440/3/60 — 1150 RPM — Star Electric Motor Co. — with across-the-line starter, with pushbutton station — mfg by Ward Leonard.

8 GEARED TURBINE-DRIVEN MAIN LUBE OIL PUMPS

Mfg. by Northern Pump Co. *PUMP:* Vertical rotary type — 750 GPM — 55#/sq. inch discharge pressure — 263 RPM — 35 BHP — oil viscosity 130 to 500 S.S.U. — 7" suction — 6" discharge. *TURBINE:* Single stage — 575# design pressure non-condensing — exhaust pressure 15# — 35 BHP — 26.39:1 gear ratio — 6940 RPM.

4 TURBINE-DRIVEN GEARED FUEL OIL BOOSTER PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 300 GPM — 150# discharge pressure — 282 RPM — 47.3 BHP — Oil viscosity 70-700 S.S.U. — 7" suction — 5" discharge. *DRIVE:* single stage impulse — 575# non-condensing — 15#/sq. inch discharge pressure.

6 FUEL OIL SERVICE PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 85 GPM — 350# discharge pressure — 560 RPM — 27.4 BHP. *TURBINE:* 1 stage — 575# non-condensing — exhaust pressure 15# — mfg. by Northern.

VALVES

THESE ARE JUST A FEW OF THE MANY VALVES OFFERED. ALL TYPES ARE AVAILABLE INCLUDING REDUCING—SENTINEL—RELIEF—MICROMETER—PRESSURE REGULATING—ANGLE, ETC! STEEL—600# SERVICE—SEND US YOUR REQUIREMENTS FOR QUOTATIONS

LESLIE 2" GOVERNOR VALVES

Type C.P. — class A — capacity 7640#/hr. — 575# steam pressure — 750# discharge pressure.

MOTOR OPERATED GATE VALVES

Low Pressure — comp. geared — 38" — mfg by Chapman Valve Co. *MOTOR DATA:* H.P. 18 ft. lbs. running torque — 45 ft. lbs. max. starting torque — 440 volts 900 RPM 3 phase 60 cycle. Type: Submersible Valve Brake — Motor: Star Electric Co.
Also available, same as listed, but 36", and 28" inch as listed, but with smaller motor.

MISCELLANEOUS

18 WIDE-RANGE FORCED DRAFT TURBINE-DRIVEN BLOWERS

9 R.H. — 9 L.H. — mfg by B. F. Sturtevant — propeller fan type — capacity 29,500 CFM/5540 RPM/250 BHP — 8250# steam/hr. — and, 9,000 CFM/1985 RPM/9 BHP — 690# steam/hr. — 7 blades — static: max 35" water — normal 21.5" water. Driven by Sturtevant turbine type VC-7 — non-condensing — single stage — 250 HP — 575# steam pressure — 15# PSIG exhaust pressure.

1250 K.W. WESTINGHOUSE TURBO-GENERATORS

(4) — Westinghouse—440/3/60 — 850° — 540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

LUBE OIL COOLERS

4 — mfg by Westinghouse. 1600 sq. ft. cooling surface — cylindrical straight-tube horizontal type. Oil capacity 590 GPM — water capacity 1500 GPM — temp. oil inlet 150°F — outlet 120 F — temp. water inlet — 85°F — outlet 90°F. Number of ¾" tubes 816 — Wall 0.049 TK — Cupro-Nickel.

MAIN CONDENSERS

Mfg. by Foster-Wheeler — 23,500 sq. ft. cooling surface — 40,500 GPM circulating water — total tubes 8,976, of cupro-nickel, as follows: (550) each ¾" x 0.06o and (8416) each ⅝" x 0.049. Monel water boxes.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity:* 210,000 lb. steam/hr. Ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters.

3 GLAND EXHAUST CONDENSERS

Foster-Wheeler — total capacity lbs./hr.: 1200 lbs. steam and 350 lbs. air — 155 sq. ft. — 4" ejector.

LARGE DEAERATING FEED HEATERS

Monel construction — spray type — capacity 480,000 lbs./hr. — vent condenser — single pass — heating surface 174 sq. ft. — all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

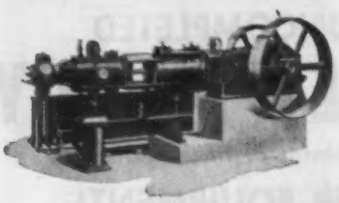
WILL SELL SEPARATELY FOR TESTING, WIND TUNNEL OR SIMILAR WORK. *(2) High pressure* — 24,400 HP — 12 impulse stages — 4909 RPM — working pressure 540# — 825°F. *(2) Low Pressure:* 28,600 HP — 3913 RPM — working pressure 49# steam — 424°F — 2-6 stages of impulse.

THE BOSTON METALS COMPANY

313 East Baltimore Street
Phone: ELGIN 5-5050

Baltimore 2, Maryland
Phone: LEXINGTON 9-1900

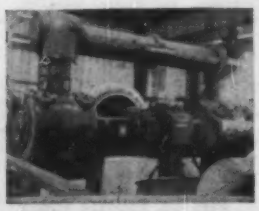
THE COMPRESSOR LINE



Three-Stage Compressor.

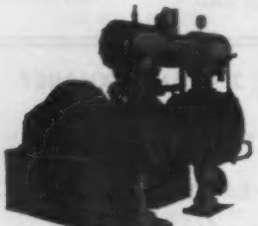
HIGH PRESSURES

97 CFM 1500 psi 6¼—3¾—1¾ x 7 CP TCB 3
106 CFM 2300 psi 9¾—4½—1-11/16x9 IR E83
311 CFM 1300 psi 10½—7¼—3½ x 13 IR E83



3700 c.f.m. Displacement 1332 INGERSOLL-RAND type 2-HNE-2 two stage air compressor, 29½—17x12. 800 H.P. G.E. sync. motor 3/60/2200. 1957 compressor—run 90 hours, crane and building available.

PENNSYLVANIA Single Stage Duplex Synchronous Motor Driven Air Compressor. 2300 CFM 50 PSI—300 H.P. This compressor used only (6) months by large oil refinery. 19—19x14 Pennsylvania DEI Duplex-single stage with 300 H.P. Elec. Mach. Sys. Motor 3-60-2300 1 PF. Can be seen on original foundation, Baltimore, Md.



1085 CFM Displacement 80-110# 277 RPM. 18—11x12 Ingersoll-Rand XRE, two stage, double acting, duplex, water-cooled, heavy duty, horizontal, synchronous motor driven air compressor equipped with: Step control; Mechanical force feed cylinder lubrication; Automatic frame oiling system; Intercooler with safety valve & pressure gauge. DIRECT CONNECTED TO: 175 HP General Electric 277 RPM unity power factor 3/60/440 volt engine type synchronous motor complete with starter and exciter.

(CAN BE SEEN RUNNING)

**For any size or make compressor try American Air.*

AMERICAN AIR COMPRESSOR CORPORATION

Dell Ave. & 47th St. North Bergen, N. J.
Union 5-4848

FOR SALE
14 NEW TURBINES

4 horizontal, 10 vertical, Westinghouse Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
Will sell turbines separately if desired.
Price reasonable.
Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volts. Used one year.

G. M. De ROSE
2457 WOODWARD AVE.
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DETROIT 1, MICH.

BABCOCK & WILCOX COAL PULVERIZERS

2—NEW UNUSED Babcock & Wilcox coal pulverizers, Type E-56, capacity 43,600# coal per hour, each equipped with American Blower Corporation air fan, 15,000 cfm capacity with motor drive.

These are complete coal pulverizer installations with blower air fans, attached and unattached structural parts. Exceptional bargain.

UTILITIES MACHINERY CORPORATION
1965 East Sixth Street, Cleveland 14, O.

DIESEL ENGINE PARTS

for Fairbanks-Morse model 38-D

BEARINGS • 10 SETS ONLY!

Main bearing 817
Connecting rod bearings 19A

A. G. SCHOONMAKER Company, Inc.

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50 Church St., New York 7, N. Y. Digby 9-4351

TURBO-GENERATOR UNITS

3 phase, 60 cycles

7500 KW, West. Condensing (2)
4160 V, 3600 RPM, 400 PSI, 750°

6000 KW, G.E., Condensing
2400 V, 3600 RPM, 200 PSI
2500 V, 3600 RPM, 850 PSI

5000 KW, West. Non-Condensing
850°—150# B.P.

1000 KW, Worth-Moore, Cond. Ext.
245/490V, 130-300# I.P., 10# Ext.

625 KW, West. Non-Condensing
480V, 3600 RPM, 200 PSI, 12-15# BP

500 KW, West. Condensing
480V, 3600 RPM, 200 PSI, 15-30# Ext.

BREW, WOLTMAN & CO., INC.
50 Church Street, New York 7, N. Y.

DIESEL ENGINE PARTS
for Fairbanks-Morse model 33F16 and 37F16
HEADS • CYLINDERS • PISTONS • BEARINGS

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50 Church St., New York 7, N. Y. Digby 9-4351

1250 K.W. TURBO GENERATORS

NEW — UNUSED
Mfg. by Westinghouse

GENERATOR:

1250 K.W.—480 volts—3 phase—60 cycle—80% P.F.—1200 R.P.M. with 10 K.W. on a 125 volt D.C. exciter.

TURBINE

560 lbs. per sq. inch gauge with 825° T.T. and one lb. per sq. inch absolute exhaust pressure. It will develop rated capacity with steam conditions of 482 lbs. per sq. inch—825° T.T. and one lb. per sq. inch exhaust pressure. Turbine R.P.M. 8050. The turbine exhausts into an auxiliary condenser.

DIMENSIONS

18'4 3/16" long—60" wide

These units originally built for Battleship Kentucky to highest Naval standards using only prime materials.

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELIGIN 5-5050 — LEXINGTON 9-1900

TRANSFORMERS

1—6667 kva. Westinghouse 3/60/115,000Y/13750
1—6000 kva G.E. 3 60000/2400/4160Y
1—2000 kva Nia. Askarel. 3/13800/4160Y/2400
3—1500 kva, Wagner, single ph. 60 cy. 6900—2400/4160Y
3—1000 kva Westinghouse, 1/22900/480
3—1000 kva Westinghouse, 1/13800/480
3—1000 kva Westinghouse, 1/13800/2400/4160Y
3—1000 kva Standard, 1/44000/6900
3—1000 kva Standard, 1/69000/4160Y/2400
3—1000 kva Standard, 1/54400/60
3—833 Allis Chalmers 1/60/12,600-480
1—800 kva, Westinghouse, 3 phase 4800/480
3—833 kva, Westinghouse, 2400/4800, 240 x 480
3—500 kva Westinghouse, 4800—240x480
3—100 kva G.E., 2400/4160Y—120x240
3— 75 kva G.E., 2400/4160Y—120x2440

ERIE ELECTRIC CO., INC.
28 Mechanic St. Buffalo 2, N. Y.

FOR SALE!!
"As Is — Where Is"

ONE—1450 K.W. 3-Phase, 60 cycle, 2300 volt Steam Power Plant. Complete with boilers and auxiliaries, turbo-generators, condensers, switchboard, spray pond equipment, etc. Will sell as a whole, or in part.

If interested, wire or write for detail description.

TIP H. ALLEN
General Superintendent
Canton Municipal Utilities
Canton, Mississippi

FOR SALE

1500 KW, 80% Power Factor, 3 phase, 60 cycle, 2300 volts, 3600 RPM, General Electric noncondensing steam turbine generator unit, 375 PSIG, 700° FTT, 125# exhaust back pressure, complete with direct connected shaft exciter and switchgear. Excellent condition—available immediate delivery.

EUCLID ENGINEERING CORPORATION
909 National City East Sixth Building
Cleveland 14, Ohio

COMPLETE MODERN 400 LB. POWER PLANT

3750 KVA Elliott Turbine Generator—563 H.P. Wickes Boiler 475 PSIG W.P.

Turbine is 440 PSIG 750° FTT Generator is 3/60/2400/4160. Surface Condenser and all auxiliaries.

This plant is complete in all respects and can be inspected as originally installed. Photographs, prints and specifications available

Other turbine Generators

1-6000 KW Allis-Chalmers	900# 830° NC 250# 13800V
1-1500 KW Westinghouse	525# 750° Non-Cond. 150# BP 2400V
1-2000 KW GE	600# 750° Non-Cond. 150# BP 4160V
2-3000 KW GE	600# 750° Non-Cond. 150# BP 2400/4160V
1-2500 KW Allis Chalmers	400# Autext 150° Non-Cond. 30# 480V
1-2500 KW Westinghouse	125# Non-Cond. 10# BP 2300V
1-2500 KW GE	400# 750° Autext 25# Condensing 600V
1-5000 KW GE	600# 750 Condensing 2300/4160
1-7500 KW Westinghouse	400# 750 Condensing 4160V

Cable Address: CHASWEAVER

CHARLES WEAVER, INC.
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DIESEL ENGINE GENERATOR UNIT

575 HP, 600 RPM, Worthington Type DH-6 Diesel engine direct connected to 500 KVA—400 KW, 80% PF, 600 RPM, 3 phase 60 cycle, 240/139 volts Electric Machinery synchronous generator complete and equipped with exciter, switchboard with instruments, attached and unattached auxiliaries to the engine. Slightly used—practically new. Immediate delivery.

UTILITIES MACHINERY CORPORATION
1965 East Sixth Street, Cleveland 14, O.

FOR SALE

4—1800 KW GENERATORS, 3600 RPM 3 Phase, 60 Cycles, 1735 Volts Unused and Good.

4—GENERATORS, Propulsion 4800 KVA 2700 Volts AC. Above units cost Gov't $50,000. ea. Will sell for fraction of cost. Unused and Good.

1—DIESEL GENERATOR SET, Diesel — Cooper Bessemer, 300 HP—750 RPM 240 Volt DC. Spare parts. Will sell for fraction of cost. Unused Good.

Electronic Instrument Corp.
457 Cortlandt St., Belleville, N.J.
PLymouth 9-3034

AUTOMATIC and MANUAL
Gas or DIESEL GENERATOR UNITS
Complete Switchboard Design and Construction
USED & REBUILT EQUIPMENT
UNIVERSAL POWER ENGINEERING CO.
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COMPLETE OIL REFINERY DESTREHAN, LA.

Including

5—Babcock & Wilcox 70,000#/hr Superheated Steam Boilers, integral furnace type, 6188 sq. ft., 450# pressure complete with stacks, blowers, drives and accompanying set of instruments. (New 1952)
1—Ingersoll Rand 2 Stage Reciprocating Compressor, type 2-HHE-2, size 29½ x 17 x 12, 3170 cfm, 125# pressure with GE 600 HP 3/60/2300 V. motor. (New November 1958)
1—Carrier Centrifugal Blower, 3 Stage, 38,300 cfm, disch. press. 32.7#.
1—Carrier Centrifugal Compressor, 6 Stage, 9,370 cfm, disch. press. 124.7#.
1—Carrier Centrifugal Compressor, 3 Stage, 9,750 cfm, disch press. 93#.
190—Centrifugal Pumps, XP motor & turbine drives, up to 9000 gpm.

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MODERN GE RECTIFIERS

3/60/13,200 AC to 600V. DC
4—1000KW Mod. 6RC-45-CD6
2— 500KW Mod. 6RG-45-CH2
Six Tube Ignitron Pump Type
Full Automatic AC & DC Controls

Can be inspected on original locations now in 1948, still like new, actual photos are available, very low price for lot.

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525 N. 20th, E. St. Louis, Ill.

MODERN BOILERS

2—50,000# per hour C-E boilers, 250 psi, coal and oil fired. Units are complete with water walls, forced and induced draft fans, all valves, soot blowers, Republic controls and auxiliary equipment.

1—110,000#± per hour C-E boiler, 675 design pressure, saturated temperature but provision for superheater, coal and oil fired, water walls, airheater, all valves, soot blowers, forced and induced draft fans. Bailey controls.

MIDWEST BOILER & TURBINE CO.
Warner, New Hampshire

MISS POWER EQUIPMENT SAYS,

"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed NEW and REBUILT MOTORS"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
500	L.A. S.B. Splash. 440 Volt	FX-1405	3600
500	G.E. S.B. Open	IK	1200
400	G.E. S.B. Open	IK-17B	900
400	L.A. S.B. Splash		1800
400	G.E. S.B. Open	IK	1200
400	West. S.B. Open	CS	900
300	G.E. S.B. Open	IK	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	G.E. S.B. Open	KT-561	720
300	West. S.B. Open CS-1002		600
300	G.E. S.B. Open	IK	600
250	El. Dyn. T.E.F.C.S.B.	KNX	1800
250	G.E. S.B. Open	KT	1800
250	West S.B. Splash CS-875		1800
250	G.E. S.B. Open 2200 Volt	IK-18	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	West S.B. Open	CS	1200
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-18S	1200
200	G.E. S.B. Open 2200 v.	IK	1200
200	Howell S.B. Open K-584		1200
200	G.E. S.B. Open	IK	900
150	LA TEFCSB	JX-114	3600
150	G.E. S.B. Drip K-8324		1800
150	West. S.S.B. Open CS-771-C		1800
150	West. S.S.B. Open CS-781C		1800
150	Al. Chal. S.B. Open AR		1800
150	West. S.B. Open 2200V	CS	1800
150	G.E. S.B. Open	KT	1200
150	F.M. S.B. Open H-24A		900
150	G.E. S.B. Open	IK	900
150	G.E. S.B. Open	KT-558	900
150	G.E. S.B. Open	IK	720
150	West TEFCSB CS-8120		1200
125	G.E. TEFCSB	K	3600
125	Burke S.B. Open 440 Volt	N-505	3600
125	Cont. TEFCSB XP AP-100		1800
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
125	Al. Chal. S.B. Open AR		1800
125	West TEFCSB	CS855	1200
125	G.E. S.B. Open	KT-558	1200
125	G.E. S.B. Open	IK	1200
125	G.F. S.B. Open	K-546	[illegible]
125	F.M. S.B. Open	H	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
100	Cont SB Splash	N584	1200
100	Howell TEFCSB K-505		3600
100	Cont. TEFCSB XP AP-505		1800
100	West. TEFCSB	CS-755	1800
100	G.E. S.B. Open	KT-543	1200
100	G.E. S.B. Open	K-504	1800
100	LA TEFCSB	JX-115	1800
100	West. TEFCSB	CS-779	1200
100	G.E. S.B. Open	KT-547	1200
100	West. SSB Open	CS-807	1200
100	F.M. S.B. Open	H29C	900
100	F.M. S.B. Open	H	720
100	F.M.S.B. Open	H	600
7[illegible]	Reliance S.B. Splash	505	1200
75	F.M. S.B. Open	H	900
75	F.M. S.B. Open	H	600
60	West. TEFCSB	CS-445	3600
60	G.E. TEFCSB	KF-443	3600
60	L.A. TEFCSB-XP EX-445		3600
60	L.A. TEFCSB	JX-443	3600
60	West. TEFCSB	CS-445	1800
60	Cont. TEFCSB	NP-504	1800
60	G.E. TEFCSB	K-504	1800
60	West. TEFCSB	CS-505	1800
60	G.E. S.B. Open	K-444	1800
60	West. S.B. Open	CS-444	1800
60	West. S.S.B. Splash CS-445		1800
60	Wagner TEFCSB CP-445		1800
60	G.E. S.B. Open	K-444	1800

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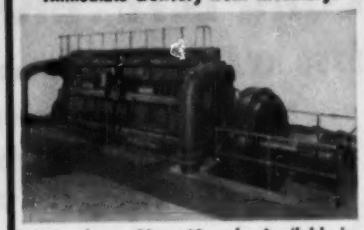
Motors, Control Equipment, AC and DC Generators, MG sets and transformers.
PHONE or WIRE us COLLECT
LARGE LINE OF SLIP RING MOTORS & CONTROLS.

POWER EQUIPMENT CO.
8 CAIRN STREET • PHONE BEverly 5-1662 • P. O. BOX 534 • ROCHESTER 2, N. Y.

DIESEL ENGINE GENERATOR SETS

Immediate Delivery from Inventory!



Any voltage; 50 or 60 cycle. Available in stationary, mobile or portable model. Following listing is only partial.

1420 kva Fairbanks-Morse model 38D—8⅛ (photo above)
1375 kva General Motors model 278A
1250 kva General Motors model 567
938 kva General Motors model 567
625 kva General Motors model 278A
825 kva American Locomotive Co. model 539
412 kva Worthington model CC
375 kva General Motors model 268A
312 kva General Motors model 268A
250 kva General Motors model 268A

A. G. SCHOONMAKER Company, Inc.

Foot of Spring St., Sausalito, Cal. Edgewater 2-1490
50 Church St., New York 7, N. Y. Digby 9-4351

BOILERS

NEW UNASSEMBLED

# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.

315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

375 KVA VERTICAL SKINNER—GE UNAFLOW GENERATING UNIT

One 14 x 12 Skinner 3-Cylinder Vertical Unaflow Engine direct connected to 375 KVA (300 KW @ 8 PF) GE 120/208 3-phase, 4-wire AC Generator 400 RPM with 10 KW GE Exciter for immediate shipment.

FRANK M. BEESON
Steam Plant Headquarters

1511 West 27th St., Los Angeles 7, Calif.
Telephone: RE 5-9820—or Western Union

DUAL FUEL & DIESEL ENGINE GENERATOR UNITS

1392 KVA Fairbanks Morse diesel engine generator unit 3 phase 60 cycle 2400/480 volts 300 RPM
Excellent condition

1250 KVA (2) Worthington supercharged diesel engine generator units 3 phase 60 cycle 2400/600/480 volts 360 RPM
New 1949 — Excellent condition

1050 KVA Nordberg supercharged diesel engine generator unit 3 phase 60 cycle 2400 volts 327 RPM
New 1947 — Excellent condition

The above units are still installed and can be adapted for Dual Fuel operation.

INTERNATIONAL POWER MACHINERY CO.
1612 Union Commerce Building—MAin 1-9514
Cleveland 14, Ohio

SURFACE CONDENSERS

Practically New

4500 Sq. Ft. Westinghouse
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A. C. MOTORS—3 ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579Bn	4800/2400	1800
1	1500	G.E.	MT-6	6600	1187
1	800	Whse.	CW	550	1775
1	600	Whse.	CW-432D-15	440	1775
1	500	Whse.	CW	550	1800
1	300	G.E.	MTP-561	2300	1200
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	336
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
1	200	G.E.	IM	2200	435
2	200	Whse.	CW-800	2300	1775

SQUIRREL CAGE

2	550	Whse.	CR-1115	2300	900
1	500	G.E.	FT-580AY	2300	3600
4	500	Whse	CR-1218	2300	900
3	500	G.E.	KF	2300	3600
2	450	Elliott	2010BB	2300	1200
2	400	Whse.	CR	4000/4000	3565
1	300	Whse.	CR-1002	2300	900
1	200	Whse.	CR-902H	2300	1175/875
1	200	G.E.	KT-557	440	1800
2	200	Whse.	CR-1115	220/440	1750
1	200	Whse.	TEFC CR872C	440	3600

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	3500	G.E.	TS-6438P	2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TB	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4000
1	2000	G.E.	514	600	2300/4000
1	1500	G.E.	720	600	6600/13200
1	1200	G.E.	514	250	6600/13200
1	1500	G.E.	600	600	2300/4160
1	1200	West.	720	600	2300/4160
1	1000	G.E.	900	260	6600
1	500	G.E.	900	250	2300/4000
1	500	G.E.	900	125/250	440
1	250	G.E.	900	125	440/4160
2	300	G.E.	1200	250	2300
1	300	Whse.	1200	600	2300
1	250	G.E.	900	250	220/440
1	240	West.	900	125	220/440
1	200	El. Mfg.	1200	250	2300/4000

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	500	G.E.	175/200# Cond. 450/2300 V.
1	1000	G.E.	150# no Cond 2400 V.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	PTR.	1	55/255
2	500	Kuhl.	OISC	1	4320x4800
3	333	G.E.	OISC	1	7200/12470Yx2400/4160Y

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300

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HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	G.E.	Slipring	2300	514
700	Whse.	Slipring	2300/4000	1200
600	G.E.	Synch.	480	900
600	Elliott (2)	Sq. Cage	2300	900
500	Allis Ch.	Slipring	2300/440	600
400	G.E.	Sq. Cage	440	1200
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2300	2600
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch.	2300/4000	400
350	Br. Boveri b.b.	Sq. Cage	4800/440	720
350	G.E.	Sq. Cage	2300	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
350	G.E.	Slipring	220/440	2600
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	220/440	514
250	G.E.	Sq. Cage	2200/440	1200
250	G.E.	Sq. Cage	2300/440	450
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E. TEFC	Sq. Cage	440	1200
250	Whse.	Sq. Cage	2300/440	600
250	Whse. (4)	Slipring	2300/440	600
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2300	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2300/440	720
150	G.E. b.b.	Slipring	2300/440	720
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2300/440	600
150	Cr. Wheeler	Sq. Cage	0/440	450
150	G.E. (2)	Sq. Cage	2200/440	1800
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2300	900
125	A.C. TEFC	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. TEFC	Sq. Cage	2300	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. TEFC	Sq. Cage	220/440	1200
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	BC	250	1450
100	Delco b.b.	late	120/240	1200
75	Allis Ch. b.b.	EB-146L	125	1500
75	G.E. b.b.	CD	250	1750
60	Ideal	D	125	1150
60	G.E. b.b.	CD	600	1750
40	Reliance b.b.	250-T	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	BC-38	230	1150
200	Whse. b.b.	8K	250	287/575
175	Cr. Wh.	150-H	230	500
150	Rel. TEFC b.b.	255G-F	230	850
150	Whse.	8K-210	230	320/1000
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
80	Whse. dyn. b.b.	8K-123L	250	1800/5000
75	Whse. (3)	8K-166	230	550/1150
75/100	Whse.	8K-191	230	300/900
60	G.E. TEFC b.b.	CD-125	230	1150
50	G.E.	BP-16	230	250/1000
50	Century new	DN-514	230	1150/1750
40	Whse.	8K-163	230	300/1200
25	Whse. (2)	8K-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2200/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
125	Whse.	250/440 AC	250 DC
100	Delco b.b.	220/440 AC	120/240 DC
75	G.E. b.b.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
75	C.W. synch.	220/440 AC	250 DC
50	G.E. b.b. (2)	220/440 AC	250 DC
35	Reliance b.b.	220/440 AC	250 DC

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4—2500 KVA W-H 34500—2400/4800
3—1500 KVA G-E 69000—2300Y
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 690000—7200/12470Y

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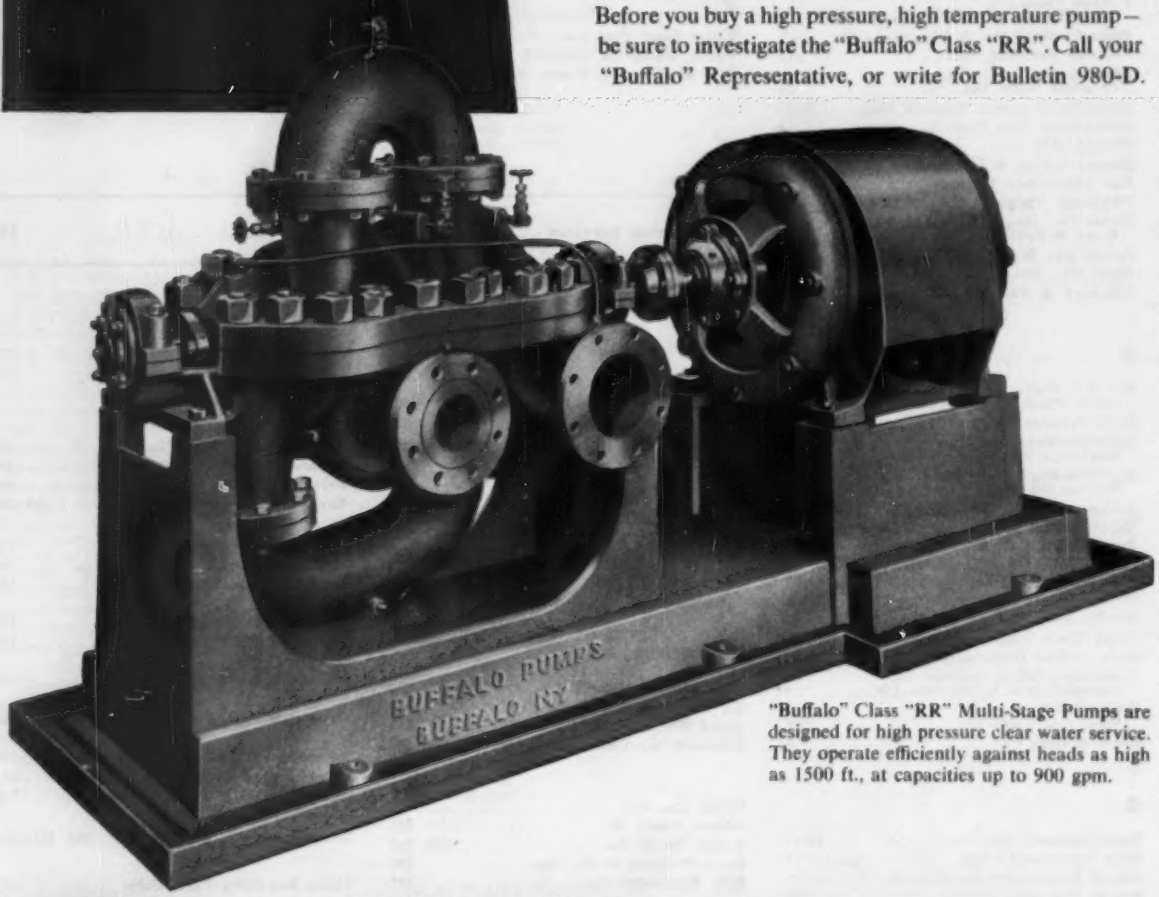

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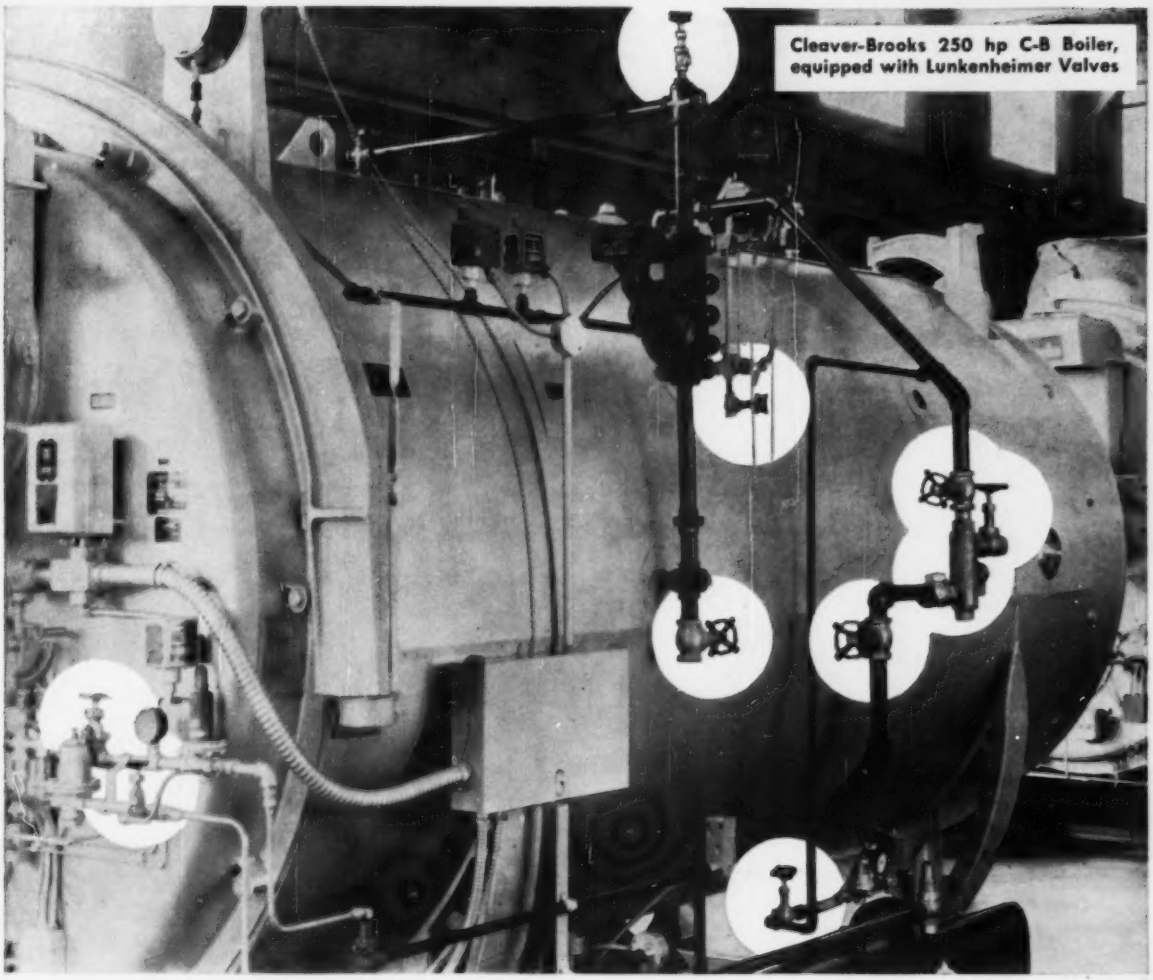

Cleaver-Brooks 250 hp C-B Boiler, equipped with Lunkenheimer Valves

TO KEEP MAINTENANCE COSTS LOW...

Cleaver-Brooks Boilers are Equipped with Maintenance-Saving Lunkenheimer Valves

Cleaver-Brooks, originator and world's largest producer of packaged boilers, stresses quality and performance. Thousands of users all over the world insist on Cleaver-Brooks Boilers because they know they can be sure of maintenance-free performance that pays for itself many times over in lower operating costs. Among the outstanding features of Cleaver-Brooks Boilers are Valves by Lunkenheimer—the longest-lasting, most maintenance-free bronze valves ever developed. Everywhere they are in service—as original equipment, on new projects, or in replacement service—Lunkenheimer Valves have established new standards for low-maintenance costs, unmatched by any other valves.

It always pays to specify the best . . . especially when the best costs no more! For specific recommendations on maintenance-saving Lunkenheimer Valves, write The Lunkenheimer Company, Cincinnati 14, Ohio.

LUNKENHEIMER QUALITY

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

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where "specifications" usually fall short

If you plan to choose your next turbine generator by dollars and specifications alone, this message is not for you.

This message is intended for the engineer who looks beyond to the things that really count—the differences that affect turbine-generator performance and life.

We at Worthington believe there are four important such differences: specialization, craftsmanship, reliability and service.

"Specialization" refers to the manufacture of turbine generators in only the size range you are planning to install. At Worthington we specialize in industrial and municipal units. We don't claim to be experts in the larger central-station machines. On the other hand, we have developed a reputation as specialists for these units in our range.

"Craftsmanship" is attention to the details that make the difference in the machine's performance. At Wellsville, N. Y., Worthington turbines are built by men with long-standing records for loyalty and skill. One foreman has been with us for 33 years. One of our machinists recently retired after 40 years' service. Turbine generators have been built in Wellsville for over 50 years.

"Reliability" is the result of *many* things, including craftsmanship, that go into each machine. Reliability has become a creed for our engineering and production personnel. Every Worthington turbine generator is completely assembled and thoroughly tested as a unit before shipment, to best assure reliable and trouble-free operation.

"Service" includes many things besides trouble-shooting. It includes specially trained engineers and mechanics for every possible need, a minimum of "red-tape" in handling the business, speed and flexibility through personal contact, fast parts service, availability of data, training of operating personnel, etc. We believe service-to-you is just as important as the machine. This range of meticulous attention to service detail has resulted in an enviable performance record for Worthington turbine generators.

The next time you choose a turbine generator, remember that there are important differences you should consider. Look at specialization, craftsmanship, reliability and service. If you do, we're convinced you'll choose "Worthington." Worthington Corporation, Wellsville, New York. 48-6

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